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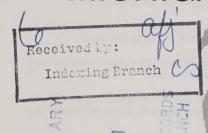


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## MICHIGAN BOTANIST



January, 1993



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## COMPARATIVE FLORISTICS OF SEVEN ISLANDS IN NORTHWESTERN LAKE MICHIGAN

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#### INTRODUCTION

Islands often have unique biotic compositions that are the result of isolation. Isolation has components of island area and distance from the mainland. The effects of these components on the biotic composition of islands were modeled by MacArthur and Wilson (1967) in the theory of island biogeography. The theory predicts that large islands have more species than smaller islands and islands close to the mainland have more species than more distant islands.

Relatively little is known about the flora of the islands of Lake Michigan. Previous studies include a floristic description of North Fox Island (Wells et al. 1975) and a botanical study by Hazlett (1988) of North and South Manitou and North and South Fox islands. Floristic descriptions of islands are important for future conservation and management practices. In addition, floristic compositions of islands can be used to test the theory of island biogeography. Several islands in Green Bay of northwestern Lake Michigan were selected for this study since little was known about the floristics of this archipelago. The islands selected were Summer, St. Martin, Poverty, Gull, Little Gull, and Gravelly islands of Delta County, Michigan and Washington Island of Door County, Wisconsin (Fig. 1). The only known floristic study in this region was conducted by Fuller (1927) and focused on Washington Island.

The objectives of this study were to collect and catalog plant species for a floristic description of the islands, to utilize these data to conduct a comparative floristic analysis of the islands, and to search for correlates between the data and the theory of island biogeography.

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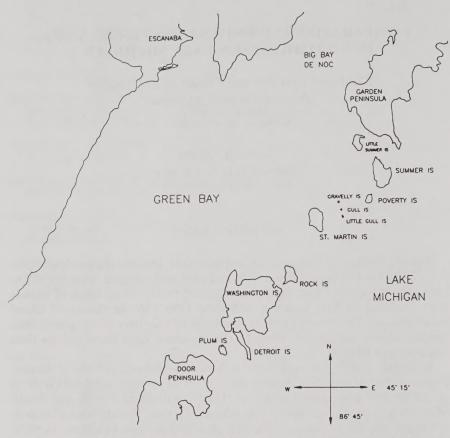


FIGURE 1. Map of northern Green Bay, Lake Michigan showing location of the islands surveyed in this study.

#### Recent Geologic History of the Region

Post glacial history indicated that the islands of Green Bay were entirely submerged during the Lake Chicago and Main Algonquin periods (11,000–10,000 BP). Drainage of the Lake Michigan basin occurred during the Chippewa low level phase and exposed the islands to plant colonization approximately 10,000 BP (Larsen 1985). During the Nipissing Transgression (4,500–4,000 BP), the lake level rose approximately seven meters above the modern level (Larsen 1985). Islands without sufficient elevation (i.e., Gravelly, Gull, and Little Gull islands; see Table 1) would have been submerged during this period. Therefore, the biota of the low elevation islands should be due to recent colonization events.

TABLE 1. Physical and botanical characteristics of seven islands in Green Bay.

Island	Area (ha)	Maximum Elevation Above Lake (meters)		Number of Plant Species
Gravelly	1.21	2.3	17.11	26
Little Gull	2.02	5.3		42
Gull	5.46	5.3		50
Poverty	77.70	9.8		177
St. Martin	523.27	21.8		183
Summer	890.98	37.3		165
Washington	5801.70	37.06		222

#### Previous Human Impact

Clear historical documentation of human factors influencing this region is scarce, but a limited understanding of human activities and their impact on these islands has been pieced together.

According to Coppess (1981), the majority of human impact occurred on these islands during the latter part of the 19th century due mainly to the profitable fishing industry that developed in this region. Records indicate that the largest human settlements were on Washington and St. Martin islands. Washington Island was the site of most human impact of the islands in this study. Modern settlement began on the island in 1835 and by 1917, Washington Island was being serviced daily by ferry and the population had reached almost 1,000 (Holland 1917). Potatoes, grains, and fruit tree crops were major components of the agricultural business conducted in the period just prior to Fuller's botanical survey of the island in 1926.

Two small villages were established on St. Martin Island and census records reported 102 people in 1870 (Coppess 1981). However, by 1900, there was no one left on the island and there has been little recorded activity on the island since.

The impact of human activity on island floras is inconclusive. However, the historical background is an important consideration when analyzing the number of species and floristic similarities among the islands.

#### MATERIALS AND METHODS

Botanical forays were conducted on the islands in early July of 1989 and 1990 by a combined team from Cranbrook Institute of Science and Oakland University. A minimum of two collection trips was made to each of the islands with the exception of Summer Island and Washington Island. Summer Island was added to our study in 1990 and was surveyed only once. We were unable to obtain a state collecting permit for Washington Island; data for this island were extracted from the Fuller survey of 1926. Fuller's survey was conducted over a two week period in mid July. Vouchers from his collecting trip are housed in the Herbarium of the Public Museum of the City of Milwaukee (MIL), where Fuller was employed as a botanist at that time. Washington Island was included in our study to increase the sample of islands and the range of island areas and distances for comparison with island biogeography theory.

TABLE 2. I	Matrix of Jaccard's	(above diagonal) ar	d Sorensen's (below	diagonal) indices of
5	similarity for seven	Green Bay islands.		

	Gravelly	Little Gull	Gull	Poverty	St. Martin	Summer	Washington
Gravelly	****	1692	.0518	.0556	.0495	.0563	.0377
Little Gull	.2941	****	.1523	.1366	.1257	.1226	.1102
Gull	.2895	.5870	****	.2362	.4430	.2918	.2353
Poverty	.0985	.2192	.2643	****	.2794	.2480	.2656
St. Martin	.1053	.2044	.22403	.4167	****	.3380	.2484
Summer	.0942	.2222	.2233	.6140	.4368	****	.2140
Washington	.0726	.1984	.1985	.3810	.4198	.3979	****

However, since the Fuller vouchers were not verified by us, conclusions regarding Washington Island should be considered tentative.

Access to the Michigan islands was provided by the U.S. Naval Sea Cadet program and the training vessel *Pride of Michigan* under supervision of Mr. Luke Clyburn. This 80 foot naval vessel provided ample facilities for the collectors to immediately press and catalog island voucher specimens. Specimens were then transferred to the Billington Herbarium at the Cranbrook Institute of Science (BLH) for final identification, mounting, and housing of the collection.

#### RESULTS AND DISCUSSION

A total of 367 species were recorded on the seven islands from the combined collections of 1926, 1989, and 1990 (see Checklist). Two species from the Michigan Threatened plant list (Michigan Department of Natural Resources 1987, Beaman et al. 1985) were documented in both 1989 and 1990: *Iris lacustris* (also classified as a federally threatened species) on Poverty and Summer islands and *Allium schoenoprasum* on St. Martin Island. The 1989 and 1990 surveys also included two species from the Michigan Special Concern plant list (Michigan Department of Natural Resources 1987): *Adlumia fungosa* on Little Gull and St. Martin islands and *Cryptogramma stelleri* on St. Martin Island.

Floristic similarity among the islands was investigated with Jaccard's and Sorensen's indices of similarity (Mueller-Dombois & Ellenberg 1974). A matrix of these similarity values is shown in Table 2. The pattern of floristic similarity among the seven islands was produced by UPGMA (unweighted pair-group method using arithmetic averages) clustering (Romesburg 1984) of Jaccard's index of similarity (Fig. 2). Little Gull and Gull islands proved to be the most floristically similar and Gravelly Island was the most floristically dissimilar. The high similarity between Gull and Little Gull islands may be due to several factors including, 1) proximity and size (Fig. 1, Table 1), 2) lack of human disturbance, 3) similar geologic histories, and 4) similar ecological conditions. Little Gull and Gull islands have elevations above lake level of 5.3 meters and would both have been submerged during the Nipissing Transgression (Table 1). When the lake receded to modern levels, these islands would have emerged as "clean slates" for recolonization by plants.

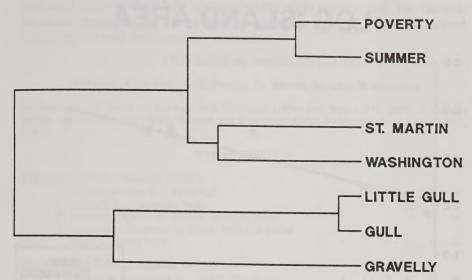


FIGURE 2. UPGMA dendrogram showing pattern of floristic similarity among the seven islands based on Jaccard's index of similarity.

Additionally, similar ecological conditions on these two islands occur as very dense colonies of gulls and cormorants. These colonial birds can affect botanical diversity in two potential ways. First, they may negatively affect botanical diversity due to the dramatic accumulation of soil nutrients from guano deposits (Hogg & Morton 1983). Secondly, they may be important vectors that positively influence diversity through biased plant colonization (Shugart 1976, Hazlett 1988).

Gravelly Island was floristically the most dissimilar. The low elevation of Gravelly Island (Table 1, Fig. 1) may be an important factor for the observed low similarity. With an elevation of only 2.3 meters above current lake level, inundation by high lake levels would result in periodic disturbance of its flora.

The close clustering of Washington Island and St. Martin Island may be due to human impact since they were the only islands with long term human habitation.

The UPGMA pattern of floristic similarity was robust in a jackknife test indicating that the pattern was not dependent upon having all of the islands in the analysis—any subset of islands produced the same pattern.

There was a highly significant correlation between the number of species occurring on the islands and island area (r = 0.904, d.f. = 5, p < 0.01; Table 1). Based on island biogeography theory, a regression of log-transformed island areas and number of species should fit a linear model (MacArthur & Wilson 1967). The linear regression equation for our total data set (log number of species = 0.249 log island area + 1.530) explained

## LOG ISLAND AREA

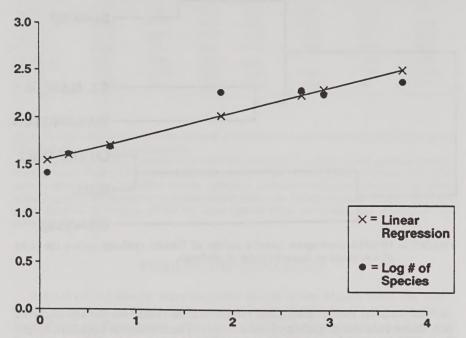


FIGURE 3. Plot of log-log relationship between number of plant species and island area. See text for equation of linear regression line.

94% of the total variation (Fig. 3). The number of plant species on these islands can largely be predicted from island area alone. Distance from the mainland was probably not an important factor affecting the number of species on these islands or floristic similarities. Wind and water currents make the mainland to the northwest of the archipelago the most likely source of seeds and spores, thus, all the islands were equally distant from the colonization source (Fig. 1).

The comparative floristic analysis of these seven islands provided the following major conclusions: 1) 367 species occur on the islands including two threatened species (*Iris lacustris*; *Allium schoenoprasum*) and two species of special concern (*Adlumia fungosa*; *Cryptogramma stelleri*), 2) the pattern of floristic similarity was concordant with geographic, geologic, and human impact factors of the region, 3) the numbers of species found on the islands strongly support the theory of island biogeography, specifically the area effect.

It is evident that these islands will be subject to increased human use in the future. Our last trip to St. Martin Island revealed increased development as large scale clearing was taking place and a large dock facility (concrete and steel, with dredged lake bottom) was recently constructed. The floristic accounts presented here may become valuable tools for future informed conservation and management decisions.

#### CHECKLIST OF VASCULAR PLANTS

(GRavelly, Little Gull, Gull, Poverty, St. Martin, Summer, Washington)

Nomenclature is based on Gleason and Cronquist (1991) and Voss (1972, 1985). Common names are from Fernald (1950), Gleason and Cronquist (1991), Swink (1974), and Voss (1972, 1985).

#### **PTERIDOPHYTES**

EQUISETACEAE (Horsetail Family)							
Equisetum arvense L. Horsetail						S	
E. hyemale L. Scouring Rush					M		W
E. scirpoides Michaux Dwarf Scouring Rush E. variegatum Schleich. ex Fried. Weber & Mohr	٠	٠	٠	٠	٠	•	W
Small Scouring Rush	•	•	٠	P	•	•	W
LYCOPODIACEAE (Clubmoss Family)				D		C	** 7
Lycopodium annotinum L. Stiff Club Moss	•	•	•	P P		S S	W
L. complanatum L. Christmas-green	•	•	:00	-			W
L. lucidulum Michaux Shining Clubmoss L. obscurum L. Ground Pine	•	•	G	P	M M	S	W
L. ooscurum L. Ground Pine	•	·	•	·	IVI	3	VV
OPHIOGLOSSACEAE (Adder Tongue Family)							
Botrychium virginianum (L.) Sw. Rattlesnake Fern	٠	•	•	P	M	S	W
OSMUNDACEAE (Flowering Fern Family)							
Osmunda regalis L. Royal Fern							W
SELAGINELLACEAE (Selaginella Family)				Р		S	
Selaginella apoda (L.) Spring Marsh Club Moss	·	·	·	Р	·	3	·
POLYPODIACEAE (Fern Family)							
Adiantum pedatum L. Maidenhair Fern	٠	•	•	•	M	٠	W
Asplenium trichomanes L. Maidenhair Spleenwort	٠	•	•	•	•	S	W
Athyrium filix-femina (L.) Roth Lady-fern	٠	•	•	P	M	S	W
Cryptogramma stelleri (S. Gmelin) Prantl							***
Rock-brake	•	•	•	•	M	S	W
Cystopteris bulbifera (L.) Bernh. Bulblet							W
Bladder-fern	•	•	•	•	•		VV
C. fragilis (L.) Bernh. Common					M	S	W
Bladder-fern					M	S	
C. laurentiana (Weath.) Blasdell Bladder-fern						S	
C. tenuis (Michaux) Desv. Bladder-fern				Р			
Dryopteris austriaca (Jacq.) Woynar Shield-fern		I.	G	Р	M	S	
D. intermedia (Muhlenb.) A. Gray Shield-fern				Р			
D. spinulosa (Mueller) Watt Shield-fern				Р		S	W
Gymnocarpium dryopteris (L.) Newman Oak-fern	. 1	L		P		S	W
Onoclea sensibilis L. Sensitive Fern	•	L			M	3	VV
Pellaea glabella Mett. Purple Cliff-brake					M		
Polypodium virginianum L. Common Polypody					M	S	
P. vulgare L. Common Polypody					M		W
Pteridium aquilinum (L.) Kuhn Bracken Fern				P	IVI		•
Thelynteris nalustris Schott Marsh Fern				-			

#### **GYMNOSPERMS**

CUPRESSACEAE (Cypress Family)							
Juniperus communis L. Common Juniper	•	•	•	•	M	•	W
J. horizontalis Moench Creeping Juniper	•	•	•	P	M		W
Thuja occidentalis L. White Cedar	•	L	G	P	M	S	W
DINIA CEAE (Dina Family)							
PINACEAE (Pine Family)		τ.	0	ъ	3.4	c	117
Abies balsamea (L.) Miller Balsam Fir	·	L	G	P	M	S	W
Larix laricina (Duroi) K. Koch Tamarack	·		·	P		S	W
Picea glauca (Moench) A. Voss White Spruce	·	·	· ·	P		3	·
P. mariana (Miller) BSP. Black Spruce	•	•	•	. P	•	•	w
Pinus resinosa Aiton Red Pine	•	·	·		M	S	W
P. strobus L. White Pine	•	•	•	·	IVI	5	W
Tsuga canadensis (L.) Carrière Hemlock	•	•	•	•	•	•	VV
TAXACEAE (Yew Family)							
Taxus canadensis Marshall Canada Yew		L	G	Р	M	S	W
		_		•			
MONOCOTYLEDONS							
CVDED A CEAE (Codes Esmille)							
CYPERACEAE (Sedge Family)				р			
Carex aquatilis Wahlemb.	Ċ	· ·		P .	M		
C. arctata Boott			•		M	S	
C. aurea Nutt. Golden Sedge	· ·	•	•		M		•
C. bebbii (L. Bailey) Fern.	•	•	•	, D	M	S	•
C. brunnescens (Pers.) Poiret	•	•	•	P	•	S	•
C. capillaris L.	•	•	•	P		•	•
C. communis L. Bailey	•	•	•	•	M	•	•
C. convoluta Mackenzie	•	•	•		M	•	•
C. deweyana Schwein	•	•	•	P	M	S	•
C. disperma Dewey	•	•	•			S	•
C. eburnea Boott	•	•	•	P	M	S	•
C. granularis Willd.	•	•	•	P	•	S	•
C. hystericina Willd. Bottlebrush Sedge	•	•	•	P		S	•
C. laxiflora Lam. Wood Sedge	•	•	•	•	M	•	*
C. lupuliformis Dewey	•	•	•	•		•	W
C. lupulina Willd. Hop Sedge	•	•	•	•	M	•	* * * * * * * * * * * * * * * * * * * *
C. lurida Wahlenb. Yellow Sedge	•	•	•	•	•	•	W
C. peckii Howe	•	•	•		•	S	•
C. pedunculata Willd.	•	•	•	P		•	•
C. retrorsa Schwein.	•	•	٠	•	M	•	•
C. rosea Willd.	•	•	•		M	S	•
C. viridula Michaux	•	•	•	P	•	S	•
Eleocharis pauciflora (Light.) Link	•	•	•	•		S	•
E. rostellata Torrey	•	•	•	•	M	•	•
Scirpus acutus Muhlenb. Great Bulrush	•	•	٠	•	•	S	****
S. americanus Pers. Three Square	•	•	•	•	•	٠	W
HYDROCHARITACEAE (Frog's-Bit Family)							
Elodea canadensis Michaux Waterweed				Р			
Stoucu cumudenoio iniciaux mater weed				4			
IRIDACEAE (Iris Family)							
Iris lacustris Nutt. Dwarf Lake Iris		•		P		S	W
I. versicolor L. Wild Iris				P		S	W
I. virginica L. Southern Blue Flag	•	•	•	P	•	•	•

Sisyrinchium montanum E. Greene Blue-eyed Grass	•	٠	٠	P		S	
JUNCACEAE (Rush Family)							
Juncus alpinus Villars				Р		C	
J. balticus Willd.				P	M	S	
J. brevicaudatus (Engelm.) Fern. Narrow-panicled				Г	IVI	3	
Rush							337
J. dudleyi Wieg.		i		P	•	S	W
J. effusus L. Common Rush		Ĭ			•	2	w
J. nodosus L.							
	•	·	•	•	•	S	W
JUNCAGINACEAE (Arrow Grass Family)							
Triglochin palustre L. Arrow-grass							W
THIACEAE (L'ILE III)							
LILIACEAE (Lily Family)							
Allium tricoccum Aiton Wild Leek	•	٠	•	•	M	S	W
Clintonia borealis (Aiton) Raf. Bluebead-lily	•	•	•	٠	M	•	W
Lilium philadelphicum L. Wood Lily	٠	•	•	P	M	S	W
Maianthemum canadense Desf. Canada Mayflower	•	L	G	P	M	S	W
Polygonatum biflorum (Walter) Elliott Solomon-							
seal	•	٠			•	•	W
P. pubescens (Willd.) Pursh Solomon-seal		•	G	P	M		
Smilacina racemosa (L.) Desf. False Spikenard					M		W
S. stellata (L.) Desf. False Solomon-seal			G	Р	M		W
Streptopus roseus Michaux Twisted-stalk					M		W
Tofieldia glutinosa (Michaux) Pers. False Asphodel				Р			W
Trillium cernuum L. Nodding Trillium				P			•
T. grandiflorum (Michaux) Salisb. Common				•			
Trillium				Р	M		W
Uvularia grandiflora Smith Bellwort					141		W
Zigadenus glaucus (Nutt.) Nutt. White Camass			G	Р	М	S	W
Zigudenus giducus (Nutt.) Nutt. Willie Calilass			U	Г	111	ی	VV
ORCHIDACEAE (Orchid Family)							
Calopogon tuberosus (L.) BSP Grass Pink	•	•		•	•	•	W
Corallorhiza maculata Raf. Spotted Coral-root		•		P	•	S	W
C. striata Lindley Striped Coral-root		•		P		S	•
C. trifida Chatel. Early Coral-root					M	S	•
Cypripedium calceolus L. Yellow Lady-slipper					M		W
C. reginae Walter Showy Lady-slipper					M		W
Goodyera tesselata Lodd. Rattlesnake-plantain					M		
Habenaria hyperborea (L.) R. Br. Tall Northern					1, 3, 3		
Bog Orchid					M	S	
H. viridis (L.) R.Br. Bracted Orchid					M	•	
Liparis loeselii (L.) Rich. Green Twayblade							W
Pogonia ophioglossoides (L.) Ker Gawler Rose							**
							W
Pogonia		·	·	·			VV
POACEAE (GRAMINEAE) (Grass Family)							
Alopecurus aequalis Sobol. Foxtail					M		
Agropyron repens (L.) Beauv. Quack Grass				P			W
A. trachycaulum (Link) Malte Bearded Wheat							
Grass					M		
Bromus ciliatus L. Fringed Brome					M		
B. inermis Leysser Smooth Brome				Р			
Calamagrostis inexpansa A. Gray Reed Grass				Р			
Dactylis glomerata L. Orchard Grass							W
Ductyus giomerata L. Otenata Grass							.,

Deschampsia cespitosa (L.) Beauv. Hair Grass				P		S	
Elymus canadensis L. Wild-rye							W
Festuca occidentalis Hook. Western Fescue		•	•	•	•	S	
F. pratensis Hudson Meadow Fescue	٠	•	•	٠	M	•	•
Milium effusum L. Wood Millet	•	•	•	•	M	•	•
Panicum capillare L. Old Witch Grass	•	•	•	•	•	•	W
P. implicatum Britton Panic Grass	•	•	•	•	٠	S	W
Phalaris arundinacea L. Reed Canary Grass	•	•	•	P	•	٠	W
Phleum pratense L. Timothy	٠	•	•	P	M	S	•
Poa annua L. Annual Bluegrass	٠	•	•	•	M	٠	•
P. compressa L. Canada Bluegrass	٠	•	G	٠	M	S	•
P. glauca Vahl Bluegrass	٠	٠	•	٠	M	•	•
P. palustris L. Fowl Meadow Grass	٠	٠	•	•	M	٠	•
P. pratensis L. Kentucky Blue Grass	•	•	•	P	M	•	•
P. saltuensis Fern. & Wieg.	•	•	•	•	•	S	•
Sphenopholis intermedia (Rydb.) Rydb.							
Wedgegrass	•	•	•	P	•	•	•
DICOTYLEDONS							
ACERACEAE (Maple Family)							
Acer rubrum L. Red Maple					M		•
A. saccharum Marshall Sugar Maple			•		M	S	W
A. spicatum Lam. Mountain Maple	•	L	G	P	M	S	W
ANACARDIACEAE (Cashew Family)							
Rhus typhina L. Staghorn Sumac					M		W
Toxicodendron radicans (L.) Kuntze Poison-ivy				Р	M		W
Toxicoacharon radicans (E.) Kuntze Toison-ivy				•	141		**
APIACEAE (UMBELLIFERAE) (Parsley Family)							
Carum carvi L. Caraway							W
Cryptotaenia canadensis (L.) DC. Honewort				M			
Daucus carota L. Queen-Anne's Lace			P				
Heracleum maximum Bartram Cow-parsnip				M			
Osmorhiza claytonii (Michaux) C.B. Clarke Sweet							
Cicely					M	S	
O. longistylis (Torrey) DC. Anise-root							W
Pastinaca sativa L. Wild Parsnip	٠			P	M	S	
Sanicula gregaria Bickn. Black Snakeroot	٠						W
Sium suave Walter Water Parsnip	٠	٠	•	٠	M	S	•
APOCYNACEAE (Dogbane Family)							
Apocynum androsaemifolium L. Dogbane							W
Apocynum unurosuemijonum E. Dogoane							**
AQUIFOLIACEAE (Holly Family)							
Ilex verticillata (L.) A. Gray Winterberry							W
(,,,,,,,,							
ARALIACEAE (Ginseng Family)							
Aralia nudicaulis L. Wild Sarsaparilla			G	P	M	S	W
A. racemosa L. Spikenard					M		W
ASCLEPIADACEAE (Milkweed Family)							
Asclepias syriaca L. Milkweed	•	•	•		M	S	

ASTERACEAE (COMPOSITAE) (Aster Family)							
Achillea millefolium L. Yarrow	R			Р	M	S	W
Ambrosia artemisiifolia L. Common Ragweed					·		W
A. psilostachya DC. Ragweed					M		·
Anaphalis margaritacea (L.) Benth. & Hook.					IVI	·	·
Pearly Everlasting				D		C	** 7
Arctium minus Schk. Burdock	D.	•	•	P		S	W
Aster ciliolatus Lindley	R	•	•	P	M	S	•
A. laevis L. Smooth Blue Aster	•	•	•	٠	M	•	•
	٠	•	•	•	M	٠	•
A. macrophyllus L. Large-leaved Aster A. pilosus Willd. Hairy Aster	•	•	•	•	M	S	•
	•	•	•	P	•	S	•
Centaurea maculosa Lam. Star Thistle	٠	٠	•	•		S	•
Chrysanthemum leucanthemum L. Ox-eye Daisy	٠	•	•	P	M	S	•
Cichorium intybus L. Chicory	•	•	•		٠	•	W
Cirsium arvense (L.) Scop. Canada Thistle	٠	•	•	P	•	S	•
C. palustre (L.) Scop. Thistle	٠	•	•	P	•	S	•
C. pitcheri (Torrey) Torrey & A. Gray Pitcher's							
Thistle	•	٠	٠	•	۰	•	W
C. vulgare (Savi) Tenore Bull Thistle	R	L	•	•	•	S	W
Coreopsis lanceolata L. Tickseed	•	•	•	•	•	•	W
Erigeron annuus (L.) Pers. Annual Fleabane	•	•	•	•	M	•	•
E. philadelphicus L. Daisy Fleabane	•	•	•	P	M	S	•
E. strigosus Muhlenb. Daisy Fleabane	٠	•	•	٠	M	S	W
Eupatorium perfoliatum L. Boneset	•	•	•	•	•	S	•
E. purpureum L. Joe Pye Weed	•	•	٠	•	•	•	W
Hieracium aurantiacum L. Orange Hawkweed	٠	•	•	P	M	S	
H. florentinum All. Yellow Hawkweed	٠	•	•	P	M	S	505
Petasites frigidus (L.) Fries Sweet Coltsfoot	٠	•	٠	•	•	S	
Rudbeckia hirta L. Black-eyed Susan	٠	•	٠	P	M	S	W
Senecio pauperculus Michaux Ragwort		•	•	P	•	S	W
Solidago canadensis L. Canada Goldenrod	•	•			•	•	W
S. flexicaulis L. Broad-leaved Goldenrod					M		
S. graminifolia (L.) Salisb. Fragrant Goldenrod				P		S	W
S. hispida Muhlenb. Goldenrod					M		•
S. houghtonii Torrey & A. Gray Houghton's							
Goldenrod							W
S. juncea Aiton Early Goldenrod				P			
S. ohioensis Riddell Ohio Goldenrod				P			
S. simplex HBK Goldenrod		L		Р		S	
Tanacetum vulgare L. Tansy				•	M		W
Taraxacum officinale Weber Dandelion				Р		S	
Tragopogon dubius Scop. Goat's Beard				P	M		
Tragopogon audius scop. Goat's Beard				•			
DALCANINA CEAE (Tauch mo not Equily)							
BALSAMINACEAE (Touch-me-not Family)				Р			
Impatiens sp.				1			
BETULACEAE (Birch Family)							
Betula alleghaniensis Britton Yellow Birch			G				W
B. papyrifera Marshall White Birch		L	G	P	M	S	W
Corylus cornuta Marshall Beaked Hazelnut		•			M		W
Ostrya virginiana (Miller) K. Koch Hop-hornbeam					M	S	W
Ostrya virginiana (winier) K. Koch Hop-normocam							

DOD A CINIA CEA E (Darage Foreile)							
BORAGINACEAE (Borage Family)  Cynoglossum officinale L. Hound's Tongue				Р		S	W
Hackelia americana (A. Gray) Fern. Stickseed						S	W
Lithospermum officinale L. Common Gromwell				Р		S	
Lunospermum officinale L. Common Groniwen				1		J	
BRASSICACEAE (CRUCIFERAE) (Mustard Family)							
Arabis canadensis L. Sicklepod	•	•	•	•	•	•	W
A. divaricarpa Nelson Rock Cress	•	•	•	P	M	•	•
A. drummondii A. Gray Drummond Rock Cress	•	•	•	•	M	S	•
A. glabra (L.) Bernh. Tower Mustard	•	•	G	•	•	•	W
A. hirsuta (L.) Scop. Hairy Rock Cress	•	•	•	P	M	•	•
A. lyrata L. Sand Cress	•	•	•	P	M	•	W
Barbarea orthoceras Ledeb. Wintercress	•	•	•	P		S	•
B. vulgaris R. Br. Yellow Rocket	•	•	•	•	•	S	•
Berteroa incana (L.) DC. Hoary Alyssum	R	•	•	•	•	•	•
Brassica kaber (DC.) Wheeler Charlock; Wild							
Mustard							W
B. nigra (L.) Koch Black Mustard	R						
Cakile edentula (Bigelow) Hook. Sea-rocket							W
Capsella bursa-pastoris (L.) Medikus Shepard's							
Purse	R	L	G				
Descurainia pinnata (Walter) Britton Tansy		_					
Mustard	R	L		P	М		
Draba arabisans Michaux	R			•			W
D. cana L.					M		•
D. sp.				Р			
	R	L	G		M		
Lepidium virginicum L. Pepper-grass							W
Sisymbrium altissimum L. Tumble Mustard			G				•
S. officinale (L.) Scop. Hedge Mustard	R						
Thlaspi arvense L. Penny Cress							W
Thuspi urvense L. Felliny Cless			·				vv
CAMPANULACEAE (Bluebell Family)							
Campanula aparinoides Pursh Marsh Bellflower	•	•	•	•	•	•	W
C. rotundifolia L. Harebell	٠	٠	•	•	M	S	$\mathbf{w}$
C. trachelium L. Nettle-leaved Bellflower	•		•				W
C. sp.		•	•	P	•		
Lobelia kalmii L. Kalm's Lobelia	٠	٠	•	٠	•	٠	W
CAPRIFOLIACEAE (Honeysuckle Family)							
Diervilla lonicera Miller Bush Honeysuckle					M		W
•	·	·		P	M		W
Linnaea borealis L. Twinflower		·		_		S	W
Lonicera canadensis Marshall Fly Honeysuckle		•		P	M		·
L. dioica L. Wild Honeysuckle	•	•		P	M	•	
L. hirsuta Eaton Hairy Honeysuckle	•	•	•	•	M	•	W
L. sp. Honeysuckle	•		G	•	•	•	* ***
Sambucus canadensis L. Common Elder	•	L	G		•	•	W
S. pubens Michaux Red-berried Elder	R	L	G	P	M	S	W
Symphoricarpus albus (L.) S.F. Blake Snowberry		•	•	P	•	S	W
Viburnum acerifolium L. Maple-leaved Viburnum		•	•	٠	•	•	W
V. lentago L. Nannyberry	•	•	•	•	•	•	W
V. opulus L. Highbush Cranberry		•		•	M		•

CARYOPHYLLACEAE (Pink Family)							
Arenaria serpyllifolia L. Sandwort	R			Р	M	S	
A. stricta Michaux Rock Sandwort							W
A. sp. Sandwort	•		G				
Cerastium fontanum Baumg. emend Jalas							
Mouse-ear Chickweed	•	•	•		M	S	
C. nutans Raf. Nodding Chickweed		•	G				•
Dianthus barbatus L. Sweet William	•	•	•	P	•	٠	•
Saponaria officinalis L. Bouncing Bet	٠	•		•	•	٠	W
Silene antirrhina L. Sleepy Catchfly	٠	٠	•	P	•	•	•
S. armeria L. Sweet William	•	•	•	P	•	•	•
S. pratensis (Rafn.) Godron & Gren. White							
Campion	•	L	G	P	٠	٠	W
Stellaria calycantha (Ledeb.) Bong. Chickweed	•	•	٠	٠	•	S	•
S. graminea L. Chickweed	•	•	٠	P	•	٠	•
S. media (L.) Villars Chickweed	•	L	٠	P	٠	S	•
CHENOPODIACEAE (Goosefoot family)							
Chenopodium album L. Lamb's Quarters		L	G				W
·		L	U				VV
CLUSIACEAE (GUTTIFERAE) (St. John's-wort Family)							
Hypericum kalmianum L. Kalm's St. John's-wort	•	•	•	P	•	S	W
H. perforatum L. Common St. John's-wort	٠	•	•	•	•	•	W
CONVOLVILLA CE A E (Marring Clary Family)							
CONVOLVULACEAE (Morning Glory Family)  Convolvulus arvensis L. Bindweed			0	Р			
Convolvulus arvensis L. Bindweed	•	•	G	Р	•	•	•
CORNACEAE (Dogwood Family)							
Cornus alternifolia L.f. Alternate-leaved Dogwood							W
C. canadensis L. Bunchberry				P		S	W
C. rugosa Lam. Round-leaved Dogwood				P	M	S	W
C. stolonifera Michaux Red-Osier Dogwood	R	L	G	P	M		W
CRASSULACEAE (Stonecrop Family)	ъ			D	3.4	C	**7
Sedum acre L. Mossy Stonecrop	R	•	G	P	M	S	W
S. telephium L. Live-forever	•	•	٠	P	M	•	•
DROSERACEAE (Sundew family)							
Drosera rotundifolia L. Sundew				٠			W
V							
ELAEAGNACEAE (Oleaster Family)				D			
Shepherdia argentea Nutt. Buffalo-berry	•	•	•	P			****
S. canadensis (L.) Nutt. Buffalo-berry	•	•	•	P	M	S	W
ERICACEAE (incl. MONOTROPACEAE) (Heath Family)							
Arctostaphylos uva-ursi (L.) Sprengel Bearberry				P	M		W
Gaultheria procumbens L. Wintergreen				•			W
Monotropa hypopithys L. Pinesap		•		•	•	S	•
M. uniflora L. Indian Pipe				•	•	•	W
EUPHORBIACEAE (Spurge Family)							**/
Euphorbia cyparissias L. Cypress Spurge	•	•	•	•	M	·	W
E. esula L. Leafy Spurge	•	•	•	•	IVI		
FABACEAE (Bean Family)							
Lathyrus japonicus Willd. Beach Pea							W
L. latifolius L. Perennial Pea					•	•	W
L. palustris L. Marsh Pea				P	•	S	W
L. Punonio L. Maron A							

Medicago lupulina L. Black Medick	R			Р	M		
Melilotus alba Medikus White Sweet Clover				•			W
M. officinalis (L.) Pallas Yellow Sweet Clover							W
M. sp. Sweet Clover		L	G				
Trifolium pratense L. Red Clover		Ĺ			M		
T. repens L. White Clover					M		
Vicia sativa Muhlenb. Vetch				Р	141		
vicia sativa Municho. Veten				1			
FAGACEAE (Beech Family)							
Fagus grandifolia Ehrh. Beech		•			M	S	W
Quercus rubra L. Red Oak		•	•		M	•	W
FUMARIACEAE (Fumitory Family)		_	_				
Adlumia fungosa (Aiton) BSP Alleghany Vine	•	L	G	•	M	٠	•
Corydalis aurea Willd. Golden Corydalis	•	•	G	•	•	S	•
GENTIANACEAE [Sentu lato] (Gentian Family)							
Halenia deflexa (Smith) Griseb. Spurred Gentian				Р		S	
Menyanthes trifoliata L. Buckbean				r		S	W
				ъ	8.	S	vv
Sabatia angularis (L.) Pursh Marsh Pink	•	•	•	Р		3	•
GERANIACEAE (Geranium Family)							
Geranium robertianum L. Herb Robert	R	L	G		M	S	
JUGLANDACEAE (Walnut Family)							
Juglans cinerea L. Butternut	•	•	•	•	•	٠	W
LAMIACEAE (LADIATAE) (Mint Equily)							
LAMIACEAE (LABIATAE) (Mint Family)							** 7
Blephilia hirsuta (Pursh) Benth. Wood Mint	•	•	•	D	1.4	•	W
Glechoma hederacea L. Ground Ivy	•	•	•	P •	M	•	***
Leonurus cardiaca L. Motherwort	•	•	•		•	•	W
Lycopus americanus Muhlenb. Bugleweed	•	•	•	P	•	S	W
Mentha arvensis L. Wild Mint	•	•	•	•	•	•	W
Monarda didyma L. Bee Balm	•	•	•	•	•	٠	W
M. fistulosa L. Wild Bergamot			•	•	•	•	W
Nepeta cataria L. Catnip	R	L	G		•	•	W
Prunella vulgaris L. Self-heal	•	•	•	P	M	S	W
Salvia sclarea L. Clary	•	•	•	****	•	•	W
Satureja glabella (Michaux) Briq. Savory	•	•	• `	P	•		•
S. vulgaris (L.) Fritsch Wild Basil	•	•	•	•	M	•	•
Scutellaria galericulata L. Marsh Skullcap	•	•	•	•	•	•	W
LENTIBULARIACEAE (Bladderwort Family)							
Utricularia cornuta Michaux Bladderwort							W
Othicularia cornata Michaux Bladdel wort							VV
MALVACEAE (Mallow Family)							
Malva neglecta Wallr. Common Mallow	R		•		•		
MYRICACEAE (Bayberry Family)							
Myrica gale L. Sweet Gale	•	•	•	P	•	•	W
NYMPHAEACEAE (Water-lily Family)							
Nuphar advena (Aiton) Aiton f. Cow-lily							W
Auphur uavena (Alton) Alton 1. Cow-my			•	·	·		VV
OLEACEAE (Olive Family)							
Fraxinus pennsylvanica Marshall Red Ash					M.		W
Syringa vulgaris L. Lilac				Р	M		

ONAGRACEAE (Evening-primrose Family)								
Circaea alpina L. Small Enchanter's-nightshade				Р		S		
C. lutetiana L. Enchanter's-nightshade				P				
Epilobium angustifolium L. Fireweed		L					W	
E. strictum Sprengel Hairy Willow-herb							W	
Oenothera biennis L. Evening-primrose	•	L	٠		M	S	W	
O. sp. Evening-primrose	R	•						
OROBANCHACEAE (Broom-rape Family)								
Orobanche uniflora L. Cancer Root				Р				
· · · · · · · · · · · · · · · · · · ·		·	·	P		·	•	
OXALIDACEAE (Wood-sorrel Family)								
Oxalis fontana Bunge Wood Sorrel	•	٠	٠	•	M	•	•	
PAPAVERACEAE (Puppy Family)								
Sanguinaria canadensis L. Bloodroot					М		W	
					141		**	
POLEMONIACEAE (Phlox Family)								
Phlox divaricata L. Wild Blue Phlox	•	•	•	•	M	•	•	
POLYGALACEAE (Milkwort Family)								
Polygala paucifolia Willd. Fringed Polygala	•				M	S	W	
P. senega L. Seneca Snakeroot				P				
DOLUCONA CEAE (Co								
POLYGONACEAE (Smartweed Family)					3.4		**7	
Polygonum amphibium L. Water Smartweed P. aviculare L. Knotweed					M		W	
P. cilinode Michaux Fringed False Buckwheat		L	G				•	
P. convolvulus L. Buckwheat	R		•					
P. virginianum L. Jumpseed					M			
Rumex acetosella L. Sheep Sorrel						S		
R. crispus L. Curly Dock	R		G					
Rumex triangulivalvis (Danser) Rech.f. Dock	R							
PORTULACACEAE (Purslane Family)		T						
Portulaca oleracea L. Common Purslane	•	L	·	•	·	·	·	
PRIMULACEAE (Primrose Family)								
Lysimachia ciliata L. Fringed Loosestrife	•	•	•	P	٠	٠	•	
L. quadriflora Sims Prairie Moneywort	•	•	٠	•	•	٠	W	
L. terrestris (L.) BSP Swamp Loosetrife	•	٠	•	٠	•	•	W	
L. thyrsiflora L. Tufted Loosestrife	٠	٠	•	•	•	S	•	
Primula mistassinica Michaux Bird's-eye Primrose	٠	•	•	P P		S	W	
Trientalis borealis Raf. Starflower	•	•	G	. Р	M	S	W	
PYROLACEAE (Shinleaf Family)								
Chimaphila umbellata (L.) Bart. Prince's Pine	•	•	•	•	M	٠	W	
Moneses uniflora (L.) A. Gray One-flowered								
Wintergreen	•	•	•	P	•	S	•	
Pyrola elliptica Nutt. Shinleaf	•	•	•	P	•	S	W	
P. secunda L. One-sided Pyrola	•	•	•	P	M	•	W	
P. virens Schweigger Shinleaf	٠	•	•	P	M	•	•	
RANUNCULACEAE (Buttercup Family)								
Actaea pachypoda Elliott White Baneberry				P	M	S	W	
A. rubra (Aiton) Willd. Red baneberry				P	M	S		
Anemone canadensis L. Canada Anemone		•	٠	P	M	S	W	
A. cylindrica A. Gray Thimbleweed	٠	٠	•	•	•	S	•	

A. virginiana L. Thimbleweed	•	•	•	•	M	S	W
Aquilegia canadensis L. Columbine	•	L	G	P	M	S	W
Coptis trifolia (L.) Salisb. Goldthread	٠	•		•	•	•	W
Hepatica acutiloba DC. Sharp-lobed Hepatica H. americana (DC.) Ker Gawler Round-lobed	•	•	٠	٠	M	٠	W
Hepatica							W
Ranunculus abortivus L. Small-flowered Buttercup					M		
R. acris L. Tall or Common Buttercup				P		S	W
	Ť	Ť					•
R. flabellaris Raf. Yellow Water Crowfoot	•	•	•	•	M	•	
R. recurvatus Poiret Hooked Crowfoot	•	•	•	•	•	•	W
R. reptans L. Creeping Spearwort	•	•	•	•	•	•	W
R. scleratus L. Cursed Crowfoot	•	•	•	•	٠	S	٠
ROSACEAE (Rose Family)							
Amelanchier interior Nielsen Serviceberry					M		
A. laevis Wieg. Serviceberry				Р	M		W
A. sanguinea (Pursh) DC. Serviceberry				•	M		
Fragaria vesca L. Woodland Strawberry			G	Р	M	S	
F. virginiana Miller Wild Strawberry				P	M	•	W
Geum aleppicum Jacq. Yellow Avens				P	M	S	w
G. canadense Jacq. White Avens					•	٠	W
Malus pumila Miller Apple				P	M		•
* * * * * * * * * * * * * * * * * * * *		·	i	P	•	S	
Physocarpus opulifolius (L.) Maxim. Ninebark		Ţ.					·
Potentilla anserina L. Silverweed	•	•	G	P	M	•	•
P. argentea L. Silvery Cinquefoil	•	٠	•	•	M	•	***
P. arguta Pursh Tall Cinquefoil	•	•	•		•	•	W
P. fruticosa L. Shrubby Cinquefoil		•	•	P	•	S	•
P. norvegica L. Rough Cinquefoil	R	•	G	P	•	S	W
P. palustris (L.) Scop. Marsh Cinquefoil	•	•	•	•	•	•	W
P. simplex Michaux Common Cinquefoil	•	•	•	•	M	•	•
P. sp. Cinquefoil	•	L	•	•	•	•	•
Prunus pensylvanica L.f. Pin Cherry	•	•	G	P	M	•	W
P. pumila L. Sand Cherry	•	•	•	•	•	•	W
P. serotina Ehrh. Wild Black Cherry	•	•		•	•	•	W
P. virginiana L. Choke Cherry	•	L	G	P	M	S	W
Rosa acicularis Lindley Red Raspberry		L	G	P		S	
R. blanda Aiton Wild Rose				P	M		W
R. eglanteria L. Sweetbrier				Р		S	W
Rubus allegheniensis Porter Common Blackberry						•	W
R. occidentalis L. Black Raspberry		L				S	W
R. parviflorus Nutt. Thimbleberry		•			M	•	W
R. pubescens Raf. Dwarf Raspberry							W
R. strigosus Michaux Red Raspberry		L	G	Р	M	S	W
Sorbus decora (Sarg.) Schneider Mountain Ash			G	Р	M	S	W
Sorous decord (Sarg.) Schneider Mountain Asir			G	Г	IVI	S	VV
RUBIACEAE (Madder Family)							
Galium obtusum Bigelow Wild Madder					•	S	
G. palustre L.					M	S	
G. trifidum L. Bedstraw			G				
G. triflorum Michaux Bedstraw		L		P	M	S	W
Houstonia caerulea L. Bluets				P		S	
H. longifolia Gaertner Long-leaved Bluets				P		S	
Mitchella repens L. Partridge-berry							W
							. ,

SALICACEAE (Willow Family)							
Populus alba L. Silver Poplar				٠	M		
P. balsamifera L. Balsam Poplar		L		Р	M	S	W
P. deltoides Marshall Cottonwood		L		٠.	M	S	**
P. grandidentata Michaux Largetooth Aspen						•	W
P. tremuloides Michaux Quaking Aspen	. /	L	G	P		S	W
Salix amygdaloides Andersson Peach-leaf Willow		L	·		M		•
S. bebbiana Sarg. Bebb's Willow				P	·	S	
S. candida Willd. Hoary Willow							w
S. discolor Muhlenb. Pussy Willow				P		•	•
S. eriocephala Michaux Willow		i		P		•	
S. exigua Nutt. Sandbar Willow		· .		_	•	S	•
S. myricoides Muhlenb. Blueleaf Willow	•	•	•	P	•	•	•
	•	•	•	P	•	•	•
S. pedicellaris Pursh Bog Willow	•	•	•			•	W
S. petiolaris Smith Slender or Meadow Willow	•	٠	•	P	M	•	٠
SANTALACEAE (Sandalwood Family)							
Comandra umbellata (L.) Nutt. Bastard-toadflax	٠	٠	•	٠	M	٠	W
CAVIEDA CA CEA E IC latal (C C E							
SAXIFRAGACEAE [Sensu lato] (Saxifrage Family)							337
Mitella diphylla L. Bishop's-cap			•	•		•	W
Ribes americanum Miller Wild Black Currant	R	L	G	•	M	•	W
R. cynosbati L. Prickly Gooseberry	•	•	•	•	•	•	W
R. glandulosum Grauer Skunk Currant	•	•	•		•	•	W
R. lacustre (Pers.) Poiret Swamp Black Currant	•	•	•	P	M	S	W
SCROPHULARIACEAE (Figwort Family)							
Castilleja coccinea (L.) Sprengel Scarlet Painted-							
cup				Р	M	S	W
Linaria vulgaris Hill Butter-and-Eggs				•		•	W
L. sp. Toadflax	R						
Melampyrum lineare Desr. Cow-wheat				Р			W
Penstemon sp. Beard-tongue				P			•
Scrophularia lanceolata Pursh Swamp Betony				P		S	W
		L		P	M		W
Verbascum thapsus L. Mullein		L		1	171		**
Veronica americana (Raf.) Schwein. American						S	
Brooklime Water Street and	Ť	·		P		S	
V. anagallis-aquatica L. Water Speedwell	•	·			M		W
V. officinalis L. Common Speedwell	•	•	•	P	M	S	VV
V. serpyllifolia L. Thyme-leaved Speedwell	•	•	•	Р	•	3	•
SOLANACEAE (Nightshade Family)							
Physalis heterophylla Nees Clammy Ground-cherry				•			W
Solanum dulcamara L. Bittersweet Nightshade				Р		S	
S. nigrum L. Black Nightshade	•	L	G	P	•	•	•
THYMELAEACEAE (Mezereum Family)							
Dirca palustris L. Leatherwood	•	•	•	•	•	•	W
TILIACEAE (Linden Family)							
Tilia americana L. Basswood					M		W
Titta americana L. Basswood							
ULMACEAE (Elm Family)							
Ulmus americana L. American Elm	•	٠	•	٠	•	S	W

URTICACEAE (Nettle family)							
Urtica dioca L. Stinging Nettle	R	L	G	P	٠	S	•
VIOLACEAE (Violet Family)							
Viola canadensis L. Canada Violet	•	•	•	•	•	•	W
V. nephrophylla E. Greene Northern Bog Violet	•	•	•	P	•	S	•
V. pubescens Aiton Yellow Violet	•	•	•	•	M		W
V. renifolia A. Gray Kidney-leaved Violet	•	•	•	•	•	S	W
V. sororia Willd. Common Blue Violet	•	٠	٠	P	•	•	٠
VITACEAE (Grape Family)							
Vitis riparia Michaux River-bank Grape	•	•	•	•	M	•	•

#### **ACKNOWLEDGMENTS**

Phyllis Higman and Paul Thompson assisted with collection and identification of plant specimens. We thank Drs. A. A. Reznicek, E. G. Voss, and W. H. Wagner, Jr. of the University of Michigan for identification of critical specimens. The manuscript was improved with the comments of N. A. Harriman and an anonymous reviewer. Financial support provided by William Slaughter is gratefully acknowledged.

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#### **ANNOUNCEMENTS**

#### SOUTHWEST MICHIGAN LAND CONSERVANCY

A new organization has been formed that is devoted to both preservation and wise use of land in southwestern Michigan. The Southwest Michigan Land Conservancy, a 501(c)3 tax-exempt organization, will concentrate its efforts on "protecting the natural beauty and diversity" in a nine-county area around Kalamazoo. The mission of the group is summarized in the following statements taken from their membership brochure:

"acquiring and protecting natural areas, historic sites, and open spaces through gifts and purchases;

providing programs and sites for outdoor recreation, nature study, and the appreciation of history;

encouraging wise land use;

enabling individuals and organizations to protect important land."

For more information about the group, please address inquiries to: SWMLC, 216 Balch St., Kalamazoo, MI 49001.

#### ANN ARBOR FLOWER AND GARDEN SHOW

The University of Michigan's Matthaei Botanical Gardens is pleased to announce the 1993 Ann Arbor Flower and Garden Show. It will be held on Thursday 25 March through Sunday 28 March at the Washtenaw Farm Council Grounds on Ann Arbor-Saline Road southwest of Ann Arbor.

The theme of this year's Show is "A Walk On The Wild Side." Plant societies, including the Michigan Botanical Club, will provide information about their activities or showcase some of the plants they cultivate and/or study. Landscape contractors and nurserymen will create varied and striking garden designs. Plants entered in the Horticulture Classes by local gardeners will also be displayed. A wide variety of gardening items will be available for purchase in the *Marketplace*.

For more information, please contact: Matthaei Botanical Gardens, 1800 North Dixboro Road, Ann Arbor, MI 48105-9741 or telephone (313) 998-7002.

#### **EDITOR'S REPORT**

When we began including an Editor's Report two years ago, much of the first report was devoted to explaining some of the reasons for the delayed appearance of *THE MICHIGAN BOTANIST*. While we think progress has been made in this area, the following numbers suggest that, the situation could worsen without some assistance from our authors (both current and potential).

As of 1 January, the manuscripts that we are handling can be summarized as follows:

Manuscripts submitted during 1992: 11 (23 in 1991)

Manuscripts ready for publication: 0

Manuscripts now in review: 2

Manuscripts rejected: 2

Manuscripts accepted, returned to the authors for corrections: 12

Accepted in 1992: 1

Accepted in 1991: 5

Accepted in 1990: 3

Accepted in 1989: 2

Accepted in 1988: 1

The drop in submissions combined with the absence of a backlog of papers ready to publish is a bit unsettling. We want to encourage anyone that has a paper to submit to do so NOW. We are aware of several submissions that are now being prepared, but it is much easier to hold papers back from a full issue than hold an issue until papers arrive (as has been done at least twice).

The numbers of papers that have been accepted and returned to the authors to make appropriate corrections over one year ago, although lower than two years ago, still seems high. While there may be an occasional set of circumstances that warrant long delays before a return, this seems to have become a major problem. Please be aware that papers that are returned over a year from initial acceptance are normally sent to review again, adding yet another step in the process.

- Richard K. Rabeler & Gary L. Hannan

#### **EDITORIAL NOTICE: LIST OF REVIEWERS**

We wish to thank the following people who reviewed articles for *The Michigan Botanist* during 1992. Their comments were essential, helping our authors to prepare clear, succinct text and to us in our position as editors. Their assistance is gratefully acknowledged.

Carmen Cid-Benevento Howard Crum Robert W. Freckmann Jay R. Harman Neil A. Harriman William H. Hess

Marilyn D. Loveless

Jon Lovett Doust James S. Pringle Joseph Rohrer Paul D. Sorensen Warren H. Wagner, Jr. Mary F. Willson

> — Gary L. Hannan Richard K. Rabeler

# CURRENT AND HISTORIC DISTRIBUTION OF GARLIC MUSTARD (ALLIARIA PETIOLATA) IN ILLINOIS

Victoria A. Nuzzo Native Landscapes 1947 Madron Road Rockford IL 61107

#### **ABSTRACT**

Alliaria petiolata is a shade-tolerant obligate biennial European herb that invades forested natural communities in the northcentral United States and adjacent Canada. Alliaria was first collected in Illinois in 1918 north of Chicago, and by 1991 had spread to 42 counties in northern and central Illinois, and two counties in southern Illinois. Rate-of-spread was exponential, with the number of new populations within equi-sized 7.5' topographic blocks (approximately 146 km²) approximately doubling every 10 years; by June 1991, Alliaria occurred in 164 blocks. Regional spread was by establishment of multiple satellite populations, and by spread as an advancing front from population centers. Seed dispersal is by natural and anthropogenic means. Floodwaters disperse seeds along river corridors, and vehicles distribute seeds along road corridors. Natural area visitors carry seeds within and between forested sites, and appear to be the primary seed vector among isolated areas. Alliaria occupies virtually all available habitat in five northeastern counties. State-wide, Alliaria occurs in 58 (30%) dedicated nature preserves and 18 (31%) state parks.

#### INTRODUCTION

Garlic mustard (Alliaria petiolata (M. Bieb.) Cavara & Grande) is a European obligate biennial herb of the Cruciferae. The plant is also known by the later name Alliaria officinalis Andrz., which is frequently used in regional floras. The common name refers to the plant's strong garlic fragrance. The life history of A. petiolata is described in Cavers et al. (1979) and Nuzzo (1991).

Alliaria petiolata (hereafter referred to as Alliaria) was first recorded in North America in 1868, on Long Island, New York (Leggett, NYS). By 1991, the taxon had spread to 28 midwestern and northeastern states, and two provinces in adjacent Canada (Nuzzo 1993). Alliaria is an aggressive species that invades moist to dry-mesic deciduous forests (Cavers et al. 1979), habitat essentially unoccupied by other alien herbs. In the late 1980's, Alliaria was recognized as a problem species in northern Illinois forest communities (Schwegman 1989). Little information was available at that time concerning the entry and spread of garlic mustard through the state, or its current distribution. This project was therefore undertaken to document regional rate-of-spread and current presence of Alliaria within Illinois.

#### **METHODS**

#### Entry and Distribution

Historic entry and distribution were determined from herbarium records, published floras, and other literature sources. Current distribution incorporated sight observations with the historical sources. All three information sources provide useful documentation of the minimum presence of *Alliaria* within the state at any given time, and are assumed to underestimate the actual extent of distribution.

The distribution map was compiled by recording, within ten year intervals, the first record or observation of *Alliaria* within 7.5 minute topographic quadrangles (approximately 146 km<sup>2</sup> in northcentral Illinois). This map indicates presence, but not abundance, of *Alliaria* in each quadrangle.

#### Herbarium Records

A total of 110 collection records obtained from 17 herbaria were compiled by decade and by county. When indicated on the herbarium label, habitat and abundance data were compiled.

Herbarium records are accurate indicators of a species' occurrence at a given time and place, but the use of such collections to document a species' spread is subject to certain limitations (Thompson et al. 1987); the species must be easily seen and identified, collections must be made at random through the entire area, and the area must be uniformly collected through the time period. The first limitation is met as *Alliaria* is highly visible and easily identifiable in flower and fruit. The second and third limitations are less easily met. Parts of the state were well botanized and other areas undercollected since the early 1800's. Collection through time may also be skewed; collectors often focus on unknown species and new county records, and these collections may serve as relatively accurate indicators of a species' entry into a local flora. However, as a species becomes established, it may be undercollected by individuals who avoid weedy and/or common species. Hence, lack of collections may indicate that a species is considered too common to collect, rather than uncommon or absent from the locale.

#### Literature

All known published floras for Illinois were examined for any reference to *Alliaria*. All potentially applicable papers and reports cited in Risser (1984), and all issues of the *Transactions of the Illinois Academy of Science* published between 1982 (hence not included in Risser 1984) and June 1991 were similarly examined. A computerized literature search of Agricola and BIOS databases using the keywords *Alliaria* and *garlic mustard* was conducted in 1990 and all citations were reviewed.

#### Sight Observations

Sight observations of *Alliaria* were made by the author, state and county biologists, volunteer stewards, and numerous other individuals for the years 1988–1991. *Alliaria* is easily identified and sight observations by qualified personnel are assumed to be correct.

#### Rate of Spread

Rate of spread was determined by recording, by decade, the first record or observation of *Alliaria* within each 7.5 minute topographic quadrangle. These data were used to map cumulative spread through time, and to graph cumulative occurrence of distribution through time.

#### RESULTS

#### Entry into state and county flora

The first record of *Alliaria* in Illinois is a 1918 collection from Ravinia, Lake County, just north of Chicago (Table 1, Figure 1). This is the first known occurrence of *Alliaria* west of central Kentucky. *Alliaria* was next collected in 1939 in Rockford, Winnebago County, some 75 miles west of Chicago. The habitat description "roadsides and near habitation" implies multiple populations in the local area.

Between 1940 and 1949, *Alliaria* was collected six times in the state, with four collections providing county records (Table 1). *Alliaria* was first mentioned in an Illinois flora in 1945 (Jones), with the comment "roadsides and waste places, common." The second written reference to *Alliaria* was a checklist of vascular plants of Winnebago County (Fuller et al. 1949). However, the species was omitted from the comprehensive *Flora of Winnebago County* (Fell 1955), indicating that *Alliaria* was not considered naturalized at that time.

Alliaria was collected from three additional counties in the period between 1950-59, including the first record from western Illinois, near the Mississippi River. Between 1960 and 1969, Alliaria was recorded in five more counties, and by the end of the decade was known from 14 counties. The new occurrences were wide spread and generally distant from other counties known to contain Alliaria.

Alliaria was collected more often in the 1970's than in any other decade. Forty-two collections were made in 23 counties, 10 of which provided new county records. In the 1980's, Alliaria was recorded from an additional 12 counties, including the first record in southern Illinois (Mohlenbrock 1986). Five of the county records are documented by herbaria specimens, and six are based on sight observations.

By June 1991, *Alliaria* occurred in 44 counties, occupying the three northern tiers of counties in Illinois, and the lowest tier of counties in Wisconsin. All but one of the 1990–1991 records were based on sight observations (Table 2).

#### Rate of Spread

Alliaria has spread exponentially through Illinois. Figure 1 depicts the first record of occurrence, by decade, of Alliaria within 164 7.5' topographic quadrangles. It is important to note that the 1990 records indicate expansion in 1 1/2 years (January 1990-June 1991) based primarily on sight observations, in contrast to the other records which represent expansion over a ten year period and are based primarily on herbarium records (Table 2). Cook County (including Chicago) is under-represented in Figure 1; Alliaria is present throughout the county, but verification of occurrence within specific sites was unavailable.

Cumulative number of occurrences by decade are graphed in Figure 2.

TABLE 1. First record of *Alliaria petiolata* presence in 44 Illinois counties. County records are listed sequentially by year within each decade. Collections made in same year are listed alphabetically by collector.

Date	County	Collector	Herbarium
1918	Lake	Colton 6	F
1939	Winnebago	Fuller & Haim 156F	ISM
1940-	Sangamon	Eifert 10207	ISM
1949	DuPage	Swink s.n.	MOR
1545	Piatt	Ahles 1048	ILL
		Albright s.n.	F
1950-	Cook	Murley	Literature
1959	Kane	Swink 959	F
	Carroll	Ahles 8027	ILL, ISM
		Buser 5027	IND
	Tazewell	Chase 14371	ILL
1960-	Grundy	Evers 63884	ILLS
1969	Boone	Evers 79913	ILLS
	Peoria	Chase 17226	ILL, ILLS
	Coles	Ebinger 4405	EIU
	Champaign	Jones 42658	ILL
		301103 12030	ILL
1970-	McHenry	Schulenberg s.n.	MOR
1979	Macon	Shildneck C-3502	ILL, ILLS
	Mason	Maier s.n.	ILL
	DeKalb	Schulenberg 74-038	MOR
	LaSalle	Evers 114796	ILLS
	Ogle	Muller 97	DEK
	Kendall	Schulenberg 75-072	MOR
	Clark	Ebinger 15778	EIU
	Will	Schulenberg 76-314	MOR
	DeWitt	Shildneck C-11810	ILL
1980-	Putnam	Ebinger 20557	EIU
1989	Fulton	Henry & Scott s.n.	MWI
1,00	Hancock	Henry & Scott s.n.	
	Shelby	Horton 25	MWI
	Kankakee		EIU
	Jackson	Swink & Shimp 7552 Mohlenbrock	MOR
	Woodford		Literature
	Knox		Sight observation
			Sight observation
	Jo Davies		Sight observation
	Lee		Sight observation
	Rock Island		Sight observation
	Stephenson		Sight observation
1990-	Vermillion		Sight observation
1991	McLean		Sight observation
	Macoupin		Sight observation
	Whiteside		Sight observation
	Logan		Sight observation
	Henry		Sight observation
	Calhoun		Sight observation
	Alexander		
			Sight observation

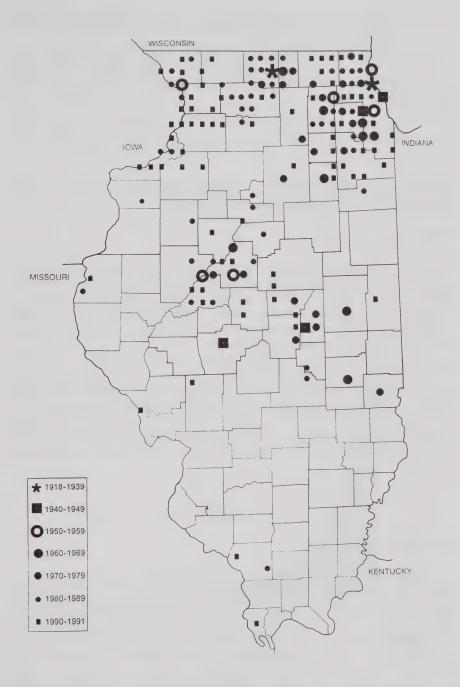


FIGURE 1. *Alliaria petiolata* distribution in Illinois 1918–1991 mapped by first record of occurrence within 7.5' topographic quadrangles (approximately 146 km²).

TABLE 2.	First record of Alliaria petiolata occurrence within 7.5' topographic quadrangles;
	number of herbaria collections, sight observations, and literature references by
	time intervals used in Table 1.

	1918-	1940-	1950-	1960-	1970–	1980-	1990-
	1939	1949	1959	1969	1979	1989	1991
Herbarium Record	2	3	6	9	17	9	0
Sight Observation	0	0	0	0	3	38	72
Literature	0	1	0	0	1	2	1
TOTAL	2	4	6	9	21	49	73

The steep upper slope of this J-curve indicates that the rate at which *Alliaria* is spreading through the state is on the increase.

#### Extent of Infestation

In five northeastern counties (Winnebago, Ogle, Cook, Du Page, and Kane) virtually all available habitat supports populations of *Alliaria*. The plant is present along roadsides, in urban areas, and in the majority of forested communities within each county. The eastern half of Lake County is similarly infested, while the western half, and adjacent McHenry County, have low to moderate levels of infestation.

Alliaria was recorded in 31% of state parks (18 of 58) and 30% of dedicated nature preserves (58 of 193) in June 1991. These percentages increase when sites outside the area of infestation are omitted from consideration. Alliaria is present in 42 counties, which contain 36 state parks (50% with Alliaria) and 141 nature preserves (41% with Alliaria). Recently invaded counties, counties with little available habitat, and counties with few natural area visitors, tend to have low to moderate levels of infestation.

#### DISCUSSION

#### Entry and Spread

Alliaria was first recorded in North America in 1868, and spread to Illinois by 1918, where it was collected north of Chicago. Mode of entry into the state is unknown, but is presumed to be related to anthropogenic activity. Alliaria was historically used as a potherb in Europe, and may have been similarly utilized by early settlers in the eastern states (Fernald et al. 1958, Brooks 1983), although there is no evidence that Alliaria was imported into the midwest as a food plant.

The species was not mentioned in state or local floras until 1945 (Jones). *Alliaria* was either not observed, or was observed but not considered established, by early botanists (Mead 1846, Lapham 1857, Bebb 1859, Brendel

#### ALLIARIA PETIOLATA

#### SPREAD THROUGH ILLINOIS

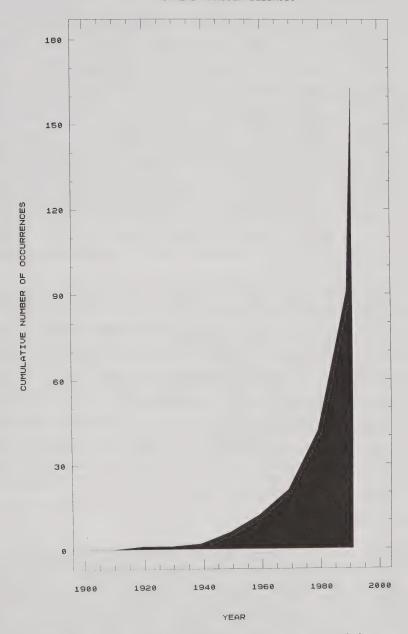


FIGURE 2. Alliaria petiolata presence in Illinois 1918–1991. Cumulative number of occurrences by decade based on herbarium collections, sight observations, and literature references.

1859, Vasey 1861, Patterson 1876, Schneck 1876, Brendel 1887, Higley and Radin 1891, Hill 1899, Pepoon 1927, Buhl 1934).

The rate at which new populations were detected approximately doubled every ten years (Table 1). From 1918 to 1939, the rate-of-spread was one quadrangle per decade. This increased to one quadrangle every 2.5 years between 1940 and 1949, every 1.7 years between 1950 to 1959, and every 1.1 years between 1960 and 1969. In the next decade, the rate of spread increased to 2.1 quadrangles each year, and by 1980 to 1989, Alliaria spread at the rate of 4.9 quadrangles per year. The increase in the last decade reflects the contribution of sight observations; 11 of the 49 records are herbarium or literature records, and 38 occurrences are sight observations made between 1985 and 1989. Without these sight records, the rate of spread curve would flatten, implying that the majority of potential habitat was occupied. This does not appear to be the case with Alliaria in Illinois. and may reflect the tendency for invasive exotics to be well collected in the early stages of invasion, and undercollected in the later stages. Sight observations in 1990 and the first half of 1991 documented an additional 72 quadrangles with Alliaria. Although there are inherent biases in combining herbarium and sight observations, the overall results indicate that Alliaria has spread and is continuing to spread at a rapid, exponential rate through available habitat in Illinois.

Between 1960 and 1989, *Alliaria* spread at the rate of 384 km<sup>2</sup> a year. When the 1990/91 observations are included, *Alliaria* is spreading, or being detected, at the rate of some 704 km<sup>2</sup>/year.

Graphing occurrences cumulatively by decade produces a classic J curve (Figure 2), indicating the exponential spread of the plant. This pattern is similar to, and in some cases more severe than, the exponential spread documented for other invasive weed species (Lacey 1957, Auld and Coote 1980, Stuckey 1980, Thompson et al. 1987), but moderate in comparison to the annual grass *Bromus tectorum* L. (Mack 1981).

In contrast to many problem herbaceous species that have been present in the state since the mid 1800s (Darlington 1922), *Alliaria* is a relatively recent invader, and increaser, in Illinois, occupying habitat unused by other alien forbs. *Alliaria*'s rapid transition from uncommon alien to invasive problem species corroborates Forcella and Harvey's (1983) findings that 'problem weed species' change over time.

#### Mode of Distribution

Alliaria is an obligate biennial that spreads exclusively by seed (Cavers et al. 1979), which typically fall within a few meters radius of the plant. Anthropogenic distribution is the major factor in long-distance dispersal of this plant (Lhotska 1975), a trait common to many weed species (Noble 1989). In Illinois, Alliaria frequently enters natural areas along roads or trails. Hikers transport seeds on muddy boots, in pant cuffs and pockets, and disperse these seeds within and between natural areas. The frequency of Alliaria in parks and preserves may be more closely related to visitors

dispersing seeds among isolated sites, than to worker bias in selecting locations for collecting or observing plants.

Roadside mowing facilitates distribution of *Alliaria* between isolated shaded areas, such as woodlots, shrubrows, and individual trees. Twenty percent of herbarium collections with habitat data were made near roads, and an additional 5% were adjacent to railroads (listed as habitat by Brooks 1983). Cars pick up seeds in mud-encrusted tires, and both cars and trains may propel seeds along the travel route.

Seeds are also dispersed long distances by natural means. Riverbanks are frequent habitats (7% of herbarium records were from riverine habitat), and rivers function as dispersal corridors for seeds. The upper stretches of the Rock, Fox, and DesPlaines Rivers are heavily infested with *Alliaria*, while the lower areas have fewer occurrences. Riverbanks and associated floodplains have a high frequency of natural disturbance (Rejmanek 1989), and provide shaded moist habitat readily invaded by *Alliaria*. Although seeds reportedly do not float well (Cavers et al. 1979), the distribution pattern in Illinois indicates that *Alliaria* disperses along rivers.

#### Habitat

Alliaria occupies a variety of habitats in Illinois, as indicated on herbarium records. Alliaria was most frequently collected from wooded communities, in particular dry-mesic upland forest, wet-mesic floodplain forest, and forested roadsides (community definitions follow White & Madany 1978). The majority of occurrences were in shaded locations, often in association with some form of anthropogenic disturbance, such as a trail, road, or railroad. This affinity for disturbed shaded habitat is typical of Alliaria's presence elsewhere in North America where it is frequently reported from floodplains (Trimbur 1973, Cavers et al. 1979), roadsides, 'waste places' and developed areas (Fernald 1970, Jones 1971, Brooks 1983). Less frequent habitats include farm fields, sunny roadsides, abandoned roadbeds, and gardens.

#### Potential Future Spread

Alliaria will continue to spread throughout the northern two thirds of the state, particularly in areas that have high disturbance rates. This taxon may invade the southern third of the state if seed is transported to suitable habitat and appropriate growing conditions are present. Throughout the state, the total area suitable for Alliaria invasion and growth will increase with increasing human development and disturbance of the natural landscape.

#### **ACKNOWLEDGMENTS**

I would like to thank the curatorial staffs of herbaria in Illinois and other states for making collection information available. Contributing herbaria are the Carnegie Museum (CM), Northern Illinois University (DEK), Eastern Illinois University (EIU), Field Museum (F), Indiana University (IND), University of Illinois (ILL), Illinois Natural History Survey (ILLS), Illinois State Museum (ISM), Kansas State College of Pittsburg (KSP), University of Minnesota (MIN), Morton Arboretum (MOR), Western Illinois University (MWI), New York State Museum (NYS), Oregon State University (OSC), Vanderbilt University (VDB), University of Wisconsin-Madison (WIS), and University of Washington (WTU). Several curators provided additional information for which I am most grateful. I especially appreciate the considerable effort expended by state and county field biologists who actively searched for Alliaria throughout the state, in particular John Alesandrini, Alan Branhagan, Dan Brouillard, Marcella deMauro, Michael Jones, Wayne Lampa, Bob Lindsey, Mike Martinez, Randy Nÿboer, Jody Shimp, Rob Shook, Mary Kay Solecki, and Todd Strole. I thank the Illinois Chapter of The Nature Conservancy for distributing observation forms through the Volunteer Stewardship Network, and the numerous individuals who provided information about Alliaria's presence in specific locations. I also thank Matt Paulson for his meticulous mapping of Alliaria's presence

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# SWAMP COTTONWOOD (POPULUS HETEROPHYLLA) IN OHIO,

James S. McCormac
Ohio Department of Natural Resources
Division of Natural Areas & Preserves
Columbus, OH 43224

Rediscovery of a species presumed extirpated from a state or region often stimulates interest and increases awareness of that taxon, resulting in detection of additional populations. An example is *Populus heterophylla* L., swamp cottonwood, in Ohio. From 1937 until its rediscovery in 1985, a lapse of 48 years, this species was not reported or collected in the state. The lack of records during this period is remarkable for several reasons. *Populus heterophylla* is a large (to 30m), easily identified tree that, although uncommon, is widespread in Ohio (Fig. 1). It belongs to a commercially valuable group of plants (trees) whose status and distribution are well known in the state. Swamp cottonwood is evident and identifiable throughout the year, unlike so many presumably rare herbaceous species which have only brief periods in which they can be detected.

Swamp cottonwood occurs primarily in two distinct physiographic provinces, the Coastal Plain from Connecticut south to Florida and west to Louisiana, and the Central Lowland from Illinois east to Ohio (Braun 1950 and Fig. 2.). *Populus heterophylla* reaches the northern limit of its range at the 42nd parallel of latitude in Connecticut (Dowhan & Craig 1976) and Michigan (Wagner et al. 1980, Pearsall 1990). Typical habitat for this species is in saturated clay substrates of swamps, sloughs, and riverbottoms (Elias 1987).

In Ohio, the earliest collection of *Populus heterophylla* is from Lake County in 1880. Thus ensued a span of 57 years in which swamp cotton-wood was regularly collected, the last historical collection from Stark County in 1937. During this initial period of collections, swamp cotton-wood was recorded from at least 26 separate locations in 17 counties. Habitat information for most of these old specimens is nonexistent, and the few labels which include habitat data are rather ambiguous, usually indicating "swamps" or "swampy woods." At that time several prolific collectors were investigating Ohio's flora, including William C. Werner and Dr. H. C. Beardslee in northeastern Ohio, Edwin L. Moseley in the western Lake Erie counties, William A. Kellerman in central and western Ohio, and A. Wetzstein in the Grand Lake St. Marys region, as well as several others.

In 1985 swamp cottonwood was rediscovered in Medina County by Jack Basinger, a local forester. This population occurs along the perimeter of an opening in a swamp forest dominated by *Cephalanthus occidentalis* L. (buttonbush). Approximately 47 mature trees and 80 saplings are present at this site, which has since been acquired by the Ohio Department of Natural



FIGURE 1. Ohio distribution of Populus heterophylla.

Resources as the Swamp Cottonwood State Nature Preserve. This discovery renewed interest and awareness of *P. heterophylla* among field botanists in Ohio, and by the end of 1991 approximately 24 populations had been located in 12 counties. *Populus heterophylla* is currently listed as potentially threatened in Ohio (Ohio Division of Natural Areas and Preserves 1990).

Two factors may account for the 48 year void between historical and modern collections of swamp cottonwood. Few botanists were afield in Ohio during most of this period, although collecting activities increased



FIGURE 2. Distribution of *Populus* FIGURE 3. Distribution of *Fraxinus tomenheterophylla*.

beginning in the early 1960's. The habitat in which swamp cottonwood occurs is often difficult to access, covered by standing water and mud, often plagued by mosquitoes, and may be avoided by some field botanists.

The majority of extant Ohio populations of *P. heterophylla* occur in waterlogged soils along the margins of buttonbush pools in swamp forest associations. All of the populations are in poorly drained areas which normally hold standing water throughout the year. At most sites swamp cottonwood tends to grow in a well-defined narrow zone corresponding with normal low water levels. *Populus deltoides* Marshall has not been observed in direct association with *P. heterophylla* at any of the sites, occurring usually on drier substrates.

Woody associates commonly found with swamp cottonwood include: Acer saccharinum L., Acer rubrum L., Cephalanthus occidentalis, Fraxinus nigra Marshall, F. pennsylvanica Marshall, Ilex verticillata (L.) A. Gray, Quercus bicolor Willd., Salix nigra Marshall, Ulmus americana L., Viburnum lentago L., and Vitis riparia Michaux. Herbaceous associates at some or all of the Ohio sites include: Amaranthus tuberculatus (Moq.) Sauer, Armoracia lacustris (A. Gray) Al-Shehbaz & V. Bates, Bidens vulgata E. Greene, Carex crinita Lam., C. cristatella Britton, C. grayi Carey, C. lupulina Muhlenb., C. muskingumensis Schwein., C. tribuloides Wahlenb., Ceratophyllum echinatum A. Gray, Cinna arundinacea L., Cuscuta gronovii Willd., Glyceria septentrionalis A. Hitchc., G. striata (Lam.) A. Hitchc., Hibiscus laevis All., Leersia oryzoides (L.) Sw., L. virginica Willd., Lemna trisulca L., Lycopus virginicus L., Lysimachia thyrsiflora L., Mimulus alatus Aiton, Platanthera flava (L.) Lindley, Polygonum

amphibium L., P. hydropiperoides Michaux, P. punctatum Elliott, Proserpinaca palustris L., Rumex verticillatus L., Saururus cernuus L., Scirpus polyphyllus Vahl., Scutellaria lateriflora L., Sium suave Walter, and Utricularia vulgaris L.

Most populations of swamp cottonwood in Ohio contain few individuals, averaging 5-15 mature trees and a variable number of small rootsprouts at a typical site. A few populations in Ashland, Medina, Mercer, Richland, and Williams counties are considerably larger, consisting of 50-80 mature trees and numerous sprouts. At least half of the extant populations have some female trees present, which fruit copiously in early June, although sexual reproduction does not appear to be the principal means of regeneration. Maintenance of *P. heterophylla* colonies is accomplished by production of vegetative root-sprouts, or suckers. These suckers radiate away from the mature trees along root systems, and usually greatly outnumber the parent trees.

Distribution of swamp cottonwood in Ohio is confined almost exclusively to the Great Lakes and Till Plains sections of the Central Lowland Province (Braun 1950). Within the Ohio portion of this Province there formerly existed an abundance of habitat for *P. heterophylla*, although most suitable areas have now been destroyed by agricultural activities, expansion of urban areas, disrupted drainage, and other development. It is possible that *P. heterophylla* occurred historically in every Ohio county within the Central Lowland Province, and may still be present but overlooked in many of these counties.

Southern Michigan represents the northern range limit of swamp cottonwood, and the tree is considered rare in that state (Pearsall 1990). Two of the largest Ohio populations are in Williams County, within 2.4 km of the Michigan state line. *Populus heterophylla* is undoubtedly present in adjoining Hillsdale County, Michigan and possibly adjacent counties. Another species, which has never been reported from Michigan but should occur in Hillsdale County, is *Fraxinus tomentosa* Michaux f. (= *F. profunda* (Bush) Bush, Gleason & Cronquist 1991), the pumpkin ash. This tree occupies the same habitat as swamp cottonwood and its distribution is nearly identical (Fig. 3). Considered rare in Ohio (Ohio Division of Natural Areas and Preserves 1990), in part possibly because it is overlooked, two of the state's pumpkin ash populations are in association with swamp cottonwood. One of these sites is in Northwest Township, Williams County, 2.25 km south of Michigan.

Habitats which are often difficult to survey and thought to be lacking in diversity and unusual plants may contain overlooked species. The history of *Populus heterophylla* in Ohio demonstrates that even a large, conspicuous tree can go undetected for a long period of time. Further survey work in appropriate habitats of Ohio, Indiana, and Michigan should reveal additional populations of swamp cottonwood.

#### **ACKNOWLEDGMENTS**

Herbaria surveyed as part of this study were CLM, GH, KE, MU, NY, OS, and PH (abbreviations follow Holmgren et al. 1990). I thank the curators of these institutions for their assistance. I wish to thank Steve McKee and Marshal Moser for providing information on populations of *Populus meterophylla* in Auglaize, Mercer, Richland, and Williams counties. I am grateful to Guy L. Denny, Jennifer A. Hillmer, Ronald L. Stuckey, and Jennifer L. Windus for their comments and suggestions. Special thanks to Jack Basinger for rediscovering swamp cottonwood and stimulating interest in this species.

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March, 1993

Flora of the Apostle Islands





# FLORA AND VEGETATION OF THE APOSTLE ISLANDS NATIONAL LAKESHORE AND MADELINE ISLAND, ASHLAND AND BAYFIELD COUNTIES, WISCONSIN

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#### **ABSTRACT**

A survey of the vascular flora of the Apostle Islands National Lakeshore and Madeline Island, Wisconsin, was conducted from 1972 to 1992. Floristically the archipelago is part of the hemlock/white pine/northern hardwoods forest, with a few boreal and sub-arctic elements such as fir clubmoss (Lycopodium selago), bird's-eye primrose (Primula mistassinica), spike trisetum (Trisetum spicatum), plains ragwort (Senecio indecorus), and butterwort (Pinguicula vulgaris), the last two occurring in Wisconsin only on the islands. The catalog of 809 species and hybrids (758 occurring within the Lakeshore) includes five species new to Wisconsin: two native, subarctic willows (Salix pellita and S. planifolia), a European rush known in North America only from Greenland (Juncus squarrosus), a Eurasian sedge new to the Great Lakes region (Carex ovalis), and a mainly eastern North American sedge (C. tincta). The only Wisconsin stations for woodland cudweed (Gnaphalium sylvaticum) and black hawthorn (Crataegus douglasii, probably introduced) also occur on the islands. The federally listed lake cress (Armoracia lacustris) occurs in the Lakeshore, along with 37 state listed species: 25 of special concern, 10 threatened, and 2 endangered. Vegetational and floristic summaries are presented for the Lakeshore as a whole, and individually for the 21 islands and Mainland Unit. The floristics and biogeography of the region are discussed and a species/area curve for the archipelago is presented.

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#### INTRODUCTION

"At a distance of one to five miles in the lake lie a cluster of wooded islands, which Carver called the Twelve Apostles. There appears to be fifteen or twenty in number, and they present a very beautiful and picturesque group . . .

Such was the impression that the Apostle Islands made on explorer Henry R. Schoolcraft as he and his party passed Chequamegon Point and the Bayfield Peninsula on their way west. Among his companions was surveyor and engineer David B. Douglass (1790–1849), who a day or two later (4 July 1820) collected beach pea (*Lathyrus japonicus*) and a rose (*Rosa* sp.) on Sand Point on the northern shore of the Bayfield Peninsula, in what is now the Mainland Unit of the Apostle Islands National Lakeshore (Douglass & Torrey 1822, Mossman 1992). Thus began the inventory of the botanical riches of this northernmost part of Wisconsin.

The Apostles are but one of a number of Great Lakes archipelagos, but they are unusual in their relatively gridlike regularity of spacing, and, to a lesser extent, their homogeneous size and topography. On the other hand, the diverse logging, agricultural, fire, and deer histories of the individual islands makes them good places to better understand the individual and combined influences of these factors on insular vegetation and floras.

The Apostle Islands National Lakeshore, created in 1970 and comprising about 17,200 ha (42,500 acres), is actually composed of 21 of the 22 islands in the Apostle archipelago (Fig. 1; Table 1); Madeline, the largest island and the only one with a permanent human population, is not a part of the

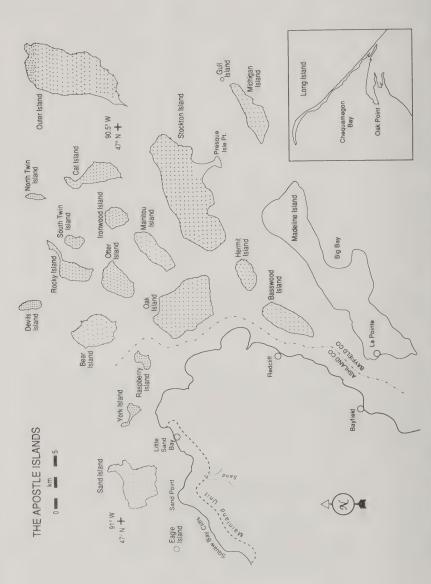
TABLE 1. Physical characteristics of the Apostle Islands.

	Area		Elevation above lake		Distance from mainland*	
	acres	ha	ft	m	mi	km
BASSWOOD	1,917	779	188	57	1.2	1.9
BEAR	1,824	741	233	71	4.5	7.3
CAT	1,352	550	81	25	11.2	18.0
DEVILS	318	130	58	18	8.9	14.4
EAGLE	24	10	21	6	2.2	3.5
GULL	3	1	3-7	1-2	14.5	23.3
HERMIT	743	302	176	54	2.3	3.7
IRONWOOD	659	268	78	24	9.0	14.5
LONG	ca. 500	203	13-16	4-5	_	_
MADELINE	ca. 14,800	6,000	198	60	1.9	3.6
MAINLAND UNIT	2,565	1,043	248	76	_	_
MANITOU	1,363	554	128	39	5.2	8.4
MICHIGAN	1,578	641	93	28	11.1	17.9
NORTH TWIN	175	71	38	12	12.9	20.8
OAK	5,078	2,064	479	146	1.3	1.7
OTTER	1,333	542	138	42	5.2	8.4
OUTER	8,000	3,252	268	82	14.8	23.8
RASPBERRY	295	120	98	30	1.7	2.9
ROCKY	1,100	447	99	30	7.7	12.5
SAND	2,949	1,199	58	18	1.2	1.9
SOUTH TWIN	360	146	48	15	9.4	15.1
STOCKTON	10,054	4,087	198	60	4.9	7.9
YORK	321	130	38	12	0.9	1.4
Total	42,511	(17,204)	(Madeline Island is excluded)			

<sup>\*-</sup>Minimum distance (from mainland to closest point on island).

Lakeshore. In addition, about 18 km of coastline along the Bayfield Peninsula (Bayfield County) are included in the Lakeshore. For further information, write the Superintendent at Lakeshore headquarters (Route 1, PO Box 4, Bayfield, WI 54814). The majority of the islands are situated in Ashland County with only Eagle, Sand, York, and Raspberry in Bayfield County; geographically, the archipelago stretches from 46°42′-47°05′N Lat. and 90°24′-91°03′W Long.

The present paper has several goals. First, to establish a floristic baseline for the islands by documenting the presence of each species on every island by a voucher deposited in a herbarium (a list of herbaria and their abbreviations is given in the explanation to the catalog). Secondly, to place the flora of the Apostle Islands in its regional context. And finally, to characterize the vegetation, unique habitats, and general "sense of place" of the Lakeshore as a whole and each individual island.



plots sampled during the present study. Long Island (lower right inset; at same scale as main map) is located about 3 km (2 miles) south of FIGURE 1. Apostle Islands National Lakeshore, Wisconsin. The gridlike pattern of dots on the islands represents the 1,424 0.01 hectare upland forest the southern tip of Madeline Island, which is not a part of the Lakeshore.

# Geology and Soils

The following summary is drawn mainly from Nuhfer and Dalles (1987). The Apostle Islands are located in the southwestern portion of the Canadian shield, a group of ancient lavas that underlie most of northeastern North America. By about 1.2 billion years ago, the present Lake Superior Basin had formed as a rift, and lavas had flowed into this separation, congealing to form the volcanic rocks that still underlie the Lake Superior region. During the next 200 million years, some of this rock eroded away and was deposited as sand by a stream system that flowed from the southwest to the northeast in the vicinity of the islands. By one billion years ago, the sand was lithified into the sandstone that forms the base of nearly all the Apostle Islands. This rock outcrops as shelves and wave-eroded cliffs on the shores of the islands and on the northern shore of the Bayfield Peninsula. The characteristic red color comes from oxidation of small amounts of iron present.

Three of these pre-Cambrian sandstone Formations are recognized in the region. The Orienta Formation includes Eagle and and the northwestern half of Sand Island, as well as the mainland coast west of Squaw Bay. The Devils Island Formation includes its island namesake, the southeastern half of Sand Island, and the mainland from Sand Point to Squaw Bay. The remainder of the archipelago, as well as the adjacent mainland, is part of the Chequamegon Formation.

The next significant event in the geological history of the islands was the advent of Pleistocene glaciation, which started about 3 million years ago and ended about 10,000 years ago. Many glaciers repeatedly covered the region; in the last major episode (the Wisconsin stage), Clayton (1985)

mapped seven advances.

The immediate post-glacial history of the region is complex (Farrand 1969) and will not be discussed in detail here. A series of temporary lakes formed in back of the retreating ice front, and several of these drained through the Brule River into the St. Croix and thus into the Mississippi system; in contrast, today Lake Superior drains through the St. Mary's River at its eastern end as part of the St. Lawrence system. The initial lake, Glacial Lake Duluth, had an elevation of 330.5 m (1,085 ft) above sea level and was drained to the south by the Bois Brule-St. Croix-Mississippi River system. In time, the ice retreated to permit drainage to the east, and the lake dropped to 183 m (600 ft), and subsequently to 137 m (450 ft) as the St. Mary straits opened. This stage (Glacial Lake Minong) occupied essentially the same area as Lake Superior. Rebounding about 5 mm per year since then (Fairbridge 1960), the general lake basin raised to its current level of 183.5 m (602 ft).

The glaciers left a thick deposit of reddish till on all of the islands, where it is exposed, especially on the western sides, as steep, clay bluffs. Generally the red, sandy-clay till is thinnest on the eastern sides, and there sandstone cliffs and ledges are most evident. Noteworthy also are gravel and cobble lake terraces that were formed by the high lake levels that occurred immedi-

ately after each glacial advance. These terraces are now high above current lake levels and can be noted at various elevations on Bear, Oak, Outer,

Rocky, and South Twin Islands.

The post-glacial history has seen the processes of erosion and deposition continuing in the archipelago. The numerous shoals were probably small islands fairly recently, even in historic times. Examples of these processes are Little Steamboat Island, washed away about 1898 (see discussion under Eagle Island), Little Manitou Island (see Manitou Island), and the continuing deterioration of Gull Island, which was recorded as part of Michigan Island in the early 19th century. On the other hand, depositional processes have apparently united several other islands by tombolos, notably Stockton with Presque Isle Point, but perhaps also Cat, Rocky, and York.

The soils of the upland areas of the Apostle Islands are mostly poorly-drained clays. Soil surveys of most of the islands have been completed (Anderson et al. 1979, 1980, 1982, 1983; Brander et al. 1978; Cary et al.

1979; Dickas et al. 1974; Kowalski 1976; Maxwell 1977).

#### Climate

Phillips and McCulloch (1972) provided a summary of climatic data for the area. The following are for Madeline Island and are representative. Maximum daily mean temperatures vary from 25.5°C in July to -4.5°C in January, and mean minimums vary from 12°C to -14°C for these months. The highest and lowest recorded temperatures are about 38°C and -35°C. Precipitation averages about 75 cm annually, including about 200 cm of snow. The growing season is about 120 days. The local climate is moderated by the "maritime" situation of the islands; compared with the adjacent Bayfield Peninsula, winters are warmer, spring arrives later, summers are cooler, and fall lasts longer. The far northern islands, Devils and Outer, have noticeably cooler climates (pers. obs.) than the ones farther south. Prevailing storm winds blow from the northwest, north, and northeast, and winter storms from these quadrants are significant factors in determining island vegetation, especially in the northwestern and northern parts of the archipelago.

Microclimatic effects are prominent, especially in the spring. During this season, mid-day temperatures in the interior of large, relatively high islands such as Outer may be 10°C higher inland than at lake level. Similarly, the Oak Island ranger cabin, situated near a ravine mouth with cold air drainage, consistently has some of the lower summer morning temperatures in the islands.

# Human History

Humans have been long-time residents of the islands. Native Americans utilized Madeline Island for settlements, and their presence continues there to this day in the maintenance of a fishing beach on Amnicon Bay by the Ojibwe (Chippewa) tribe. French explorers and traders began visiting the

islands in the early 17th century, and first established a trading post on Madeline in 1693. The settlement of La Pointe was one of the most important commercial and administrative centers in the Lake Superior region in the 18th and early 19th centuries, but declined in importance as the fur trade declined and the railroads extended north. Lighthouses were built on five islands in the late 1800's, and their adjacent "reservations" of uncut forest have survived on Devils, Outer, and Raspberry Islands to give some idea of the original vegetation of the archipelago. Logging began in the mid-19th century and continued for a century (Lidfors 1984). In the 1890's, excellent brownstone building stones were quarried from Basswood, Hermit, and Stockton Islands, a fishing and an early tourist trade began, and homesteads were established on some islands. However, by the early 20th century, iron and masonry replaced stone for building material, lumbering proved difficult, and the farmers left their isolated homesteads. Today the islands are largely covered with luxuriant second growth forest. Summaries of each island's history are given later in the paper and more information is given by Burnham (1929), Ross (1951, 1960), Holzhueter (1974), and Strzok (1981).

# History of Botanical Research

As noted, Schoolcraft's party was the first to collect plants within the boundaries of the Lakeshore. The next botanical visitor was Douglass Houghton (1809–1845), who in 1832 collected several species, among them jointweed (*Polygonella articulata*) and the rare linear-leaved sundew (*Drosera linearis*), from "La Pointe" (Rittenhouse & Voss 1962), perhaps at the Big Bay barrier beach and bog on Madeline Island. Another early collector was Increase A. Lapham (1811–1875), an outstanding Wisconsin scientist and proto-preservationist, who visited La Pointe in September 1858. He may have made a brief, earlier trip to Madeline Island, because a specimen of the sedge *Carex intumescens* housed at the University of Wisconsin-Madison herbarium (WIS) bears the date June 1856.

Born in Ohio and trained as a bryologist, walrus-mustached Lellen S. Cheney (1858–1938) was curator of WIS from 1891–1903. On one extended field trip during the summer of 1896, he explored the Lake Superior shore from the mouth of the Montreal River west to Chequamegon Point, then Long Island, followed by several other islands. Care must be taken when interpreting his series (5258–5300) made on 23 July from the "Lake shore from Trout Stream [the Bad River] to Chaquamegon [sic, for Chequamegon] Point (or Long Island) . . ." Most of these collections were probably not made within the present boundaries of the National Lakeshore, as evidenced by the presence of bog plants such as dragonmouth (Arethusa bulbosa) that are not known from Long Island. More likely he collected them in the Sand Cut Slough bog at the base of Chequamegon Point (not in the Lakeshore), where they still grow. He then proceeded to Long Island proper (5301–5428), and nearly a century later his station for Loesel's tway-blade (Liparis loeselii) —the only record for the Lakeshore—still exists.

Cheney was the first to collect on Basswood ("Bass"), Hermit ("Wilson's"), Manitou, Oak, Sand, and Stockton ("Presque Isle") Islands, and he also visited Madeline Island. His total of 631 collections (deposited at WIS, MIL, and MIN) from the study area includes 251 made in 1897 in what is now the Mainland Unit of the Lakeshore, from Sand Bay (where he made the only regional collection of the calypso orchid, *Calypso bulbosa*) to the Squaw Bay cliffs.

From 24 June to 7 July 1907, an expedition from the Milwaukee Public Museum (MIL) visited the Apostle Islands. The collection labels list no collectors and specific islands and we were unable to turn up any more information on this series at MIL. It seems likely that the specimens came from Madeline Island because they include some common southern species otherwise unknown from the archipelago such as tower mustard (*Arabis glabra*) and strawberry-blite (*Chenopodium capitatum*). Dragonmouth could have been gathered at Big Bay bog, and black snakeroot (*Sanicula marilandica*) and American brooklime (*Veronica americana*) from mesic ravines, where they still grow on the island.

Although making but few collections (deposited at WIS), plant pathologist Eben H. Toole (1889–1967) was apparently the first to collect plants on Bear and Michigan Islands, in 1910. Charles Goessl (1866–1941), a professional collector employed by MIL, made 166 collections on Madeline, Oak, and Stockton Islands in 1917. His most interesting discovery was Michaux's sedge (*Carex michauxiana*) in Julian Bay bog on Stockton Island. On 10 July 1919, Wisconsin mammologists Hartley H. T. Jackson (1881–1976) and Henry H. Sheldon made the first collections from Outer Island (deposited at WIS), apparently on Sand Point at the southern tip.

Except for brief visits by WIS curator Norman C. Fassett to Oak Island in 1938, and first collections from Rocky (as "Rice's") and South Twin Islands by Katherine E. Dorney on 2 June 1947, there was a 36 year hiatus in systematic botanical exploration until the mid-1950's, when two major programs began, that of Northland College's (NCAW) Franklin C. Lane,

and that of John T. Curtis and his collaborators from WIS.

Lane (1928–1971), an instructor at the Ashland college, led an ambitious collecting program based at Laurie Nourse Sr.'s resort on Rocky Island during the summers of 1955 and 1956 (Lane & Caskey 1957; 257 species listed). The Brooklyn-born botanist visited all islands except Eagle and was the first to collect on Cat, Devils, Gull, Ironwood, North Twin, Otter, Raspberry, and York Islands. Amassing about 750 specimens, which are deposited mainly at WIS and NCAW, his most important finds were butterwort (*Pinguicula vulgaris*) from both Devils and Otter, plains ragwort (*Senecio indecorus*) from North Twin, and bird's-eye primrose (*Primula mistassinica*) from Devils and York Islands. He later moved to Frostburg State College in Maryland where he died of cancer at the age of 42.

This period also witnessed the first systematic ecological studies of island forests in the form of the University of Wisconsin Plant Ecology Laboratory (P.E.L.) project led by Curtis (1913–1961), who had first visited the islands in 1938 with Fassett. He and his students and colleagues Grant

Cottam, P. F. Maycock, Edward W. Beals, and M. F. and R. J. Vogl were able to visit 18 islands and measure vegetational parameters in 76 sample plots during the years 1955–1958. Their findings were presented in a number of papers (Beals 1958, Beals et al. 1960, Beals & Cottam 1960, Maycock & Curtis 1960, Beals 1965). All collected some vouchers, particularly Beals; 500 specimens are deposited at WIS.

There followed another decade-long hiatus until Wisconsin Department of Natural Resources botanists William E. Tans and Robert H. Read made visits to ten islands from 1971-1978, taking extensive notes on endangered plants and plant communities (Tans 1971, 1978, 1983, 1988; Tans & Read 1971, 1975), making many interesting finds, and collecting some vouchers (deposited at MIL and WIS). Other visitors during this period were MIL pteridologist W. Carl Taylor in 1977 (Taylor & Luebke 1977) and 1980, and WIS caricologist Theodore S. Cochrane and his wife Barbara in 1980. From about the mid-1970's on, park ecologist Robert B. Brander (Brander et al. 1978) participated in or co-ordinated detailed ecological studies of many islands (Basswood, Cat. Hermit, Manitou, Michigan, Outer, Rocky, and South Twin) and facilitated many other surveys. University of Wisconsin-Stevens Point (UWSP) biologist Raymond K. Anderson and his students made detailed ecological studies of Basswood, Hermit, Manitou, Outer, Sand, and Stockton Islands during this period (Anderson et al. 1979, 1980, 1982, 1983, 1985; Fraundorf 1984), compiling numerous species lists and collecting some vouchers that are housed at UWSP and the Lakeshore herbarium in Bayfield (APIS). Ecological studies during this period also encompassed Bear (Larsen 1975), Oak (Hildebrandt 1978a, 1978b), South Twin (Heidel 1977), Stockton (Stadnyk et al. 1974), and Raspberry, Rocky, and York (all by Dobie [1977]) Islands, as well as the Mainland Unit (Dickas et al. 1974). The approximately 500 collections of biologist Beth A. Middleton as a graduate student (at Iowa State University, ISC), park employee (1978–1982, specimens deposited at APIS), and later with her own students (1988–1992) at Southern Illinois University turned up numerous interesting records, particularly on sandscapes and in the wetlands and shallow waters off Long Island.

Non-vascular plants have been the object of several studies: bryophytes by Allen (1902), Hermann (1978), and the ongoing work of Frank Bowers (UWSP); and a checklist of at least 271 species of lichens (Wetmore 1990).

# Scope of Present Study

Koch made 36 collecting trips totalling 44 field days to the Lakeshore from 1972–1983, gathering 3,274 specimens (including bryophytes). These are deposited at UWL (first set), WIS, UWSP, MIL, and OSH. Also completed during this time were two preliminary checklists of the islands' flora (Koch 1978, with 467 species; 1980, with 514 species). Excluding a brief visit to Long Island in 1987 with Jim Meeker, Judziewicz made 49 collecting trips totalling 150 field days during 1990–1992; 3,985 collections were made and all are deposited at WIS. Combining both authors' field work, each island

TABLE 2. Botanical summary of the Apostle Islands.

	Vascular plant species Total Alien % Alien			Species per 0.01 ha sample plot (mean)	Yew cover (mean;
BASSWOOD	268	45	17	18.5	< 0.1
BEAR	235	26	11	10.8	0.8
CAT	195	22	11	10.1	55
DEVILS	250	42	17	9.3	24
EAGLE	74	17	23	_	ca. 75
GULL	50	24	48	_	0
HERMIT	232	27	12	17.7	0.3
IRONWOOD	176	34	19	9.1	60
LONG	356	43	12	_	0
MADELINE	534	125	23	_	< 0.1
MAINLAND UNIT	310	49	16	_	< 0.1
MANITOU	228	36	16	11.7	1.2
MICHIGAN	325	59	18	15.0	39
NORTH TWIN	124	8	6	6.7	81
OAK	308	44	14	16.7	< 0.1
OTTER	228	28	12	12.6	53
OUTER	366	48	13	14.9	38
RASPBERRY	266	56	21	7.9	83
ROCKY	284	40	14	11.3	0.4
SAND	311	68	22	13.4	58
SOUTH TWIN	227	34	15	13.6	1.6
STOCKTON	429	51	12	20.2	0.5
YORK	167	14	8	8.1	78
Island Records*	5,633	891	15.8		
Total Flora	809	173	21.4	14.5	20**
Total Lakeshore Flora***	758				

\*Excludes Mainland Unit.

\*\*Excludes Madeline Island and Mainland Unit.

\*\*\*Excludes 51 species only known from Madeline Island.

has been visited at least five times during different periods of the year, except for the bird sanctuaries Eagle and Gull Islands, which were each visited only twice. It is believed that the species coverage (809 taxa; Table 2) of the archipelago as a whole represents about 98% of the true figure, while the "island voucher" total of 5,633 (up from about 1,000–1,500 when the survey started in 1972) is within 90% of the true figure. The Mainland Unit was not systematically collected for common taxa and its total of 310 species probably represents only two-thirds of the actual number present.

The first author also completed a vegetational survey of 1,424 upland forest plots throughout the archipelago during 1991–1992. These are indicated by the grid of dots in Fig. 1. Each 0.01 hectare plot was circular (radius: 5.64 meters) and was located on a compass-line transect at 200, 300,

or 400 meter intervals, depending on the size of the island. These data are being worked up for publication (copies of data sheets are on file at Lakeshore headquarters) in separate papers, but some of it is presented here in the form of distribution maps of several plant species (Figs. 4, 5, and 26), data on Canada yew (*Taxus canadensis*) coverage (Table 2), and the average numbers of species found on plots on different islands (Table 2; Figs. 13 and 14).

#### PLANT COMMUNITIES

#### Hemlock/White Pine/Northern Hardwood Forests

In pre-settlement times about 90% of the Apostle Islands were covered by an upland mixed coniferous/hardwood forest (Finley 1976, Rakestraw et al. 1976, Frederick & Rakestraw 1976, Brander 1978) dominated by hemlock (Tsuga canadensis), white pine (Pinus strobus), sugar maple (Acer saccharum), yellow birch (Betula alleghaniensis), and white birch (Betula papyrifera). Scattered throughout were small stands of red oak (Quercus rubra), especially in better-drained locations. In more poorly-drained sites or in places exposed to the prevailing winds where wind-throw is a major factor (Canham & Loucks 1984), balsam-fir (Abies balsamea) and white cedar (Thuja occidentalis) were important trees. Quaking aspen (Populus tremuloides), large-toothed aspen (Populus grandidentata), showy mountain-ash (Sorbus decora), white spruce (Picea glauca), basswood (Tilia americana), and hop-hornbeam (Ostrya virginiana) were minor components of the upland forest.

With logging, the forest composition changed. First, the large white pines were removed from the 1880's to about 1900. Then the large hemlocks, yellow birch, and sugar maples were cut until nearly all virgin stands were gone by 1950. Often, severe slash fires followed logging and burned large sections of some islands (Beals & Cottam 1960). Finally, logging for a wide range of species continued until the 1970's (Frederick & Rakestraw 1976).

Presently hemlock, at its northern and close to its northwestern range limits in the Apostles, is not a dominant tree except in a few small, relict stands on Bear, Oak, Outer, and Stockton Islands. Regeneration is rare. White pines are limited to maturing second growth stands on sandscapes and scattered super-canopy individuals on Outer and Sand and unlogged or lightly logged Devils and North Twin Islands. In the long-term, sugar maple (a relict virgin stand on Oak Island is shown in Fig. 19) appears to have benefited most from the decline of these species; on well-drained upland second-growth stands on many islands it is thriving and is the only forest tree exhibiting good seedling and sapling recruitment. Aspens and white birch increased dramatically in the first decades after logging ceased; the aspens are now mature and in decline. White birch, sugar and red maples,



FIGURE 2. Thick growth of Canada yew (*Taxus canadensis*) in forest understory of deerless Raspberry Island. Photograph by J. F. Van Stappen, 11 May 1992.

balsam-fir, and white cedar are now the most important tree species in the archipelago.

In the understory of the pre-settlement forest, Canada yew was the dominant shrub (Fig. 2) on many if not all islands (except Long). This changed after logging. After World War II, a severe irruption of white-tailed deer, which prefer yew to nearly any other food (Curtis 1961), led to the near extirpation of Taxus from many Apostle Islands. Pre-1946 records are anecdotal but suggest that yew was still abundant on most of the islands and deer uncommon or absent. Deer became common in the late 1940's and peaked in the mid-1950's, and yew suffered accordingly (Fig. 3). Subsequently, their populations were curtailed by liberal hunting seasons and a series of severe winters in the late 1960's (Brander & Bailey 1983). Today, yew (Fig. 4; Table 2) is still dominant on those islands without a history of white-tailed deer irruptions including Outer, North Twin, Raspberry, York, Eagle, and Devils Islands (Allison 1987, 1990). Of particular interest are the several islands (Cat, Ironwood, Michigan, and Otter) that had a moderate deer population but still retain dominant yew. On islands with very low current yew cover, irruption-era deer densities ranged from 2.0-7.2 (-15.2 on Rocky)/mi<sup>2</sup>, with Oak Island having only 1.0/mi<sup>2</sup>. Fire history may also be important in explaining yew abundance: yew is much less common on the southern half of Outer Island, which was logged and then severely burned, than on the northern half, which was high-graded for hemlock and hard-



FIGURE 3. Canada yew stripped of all foliage by high populations of white-tailed deer, Rocky Island. Photograph by D. R. Thompson, Wisconsin Conservation Department, 24 August 1955.

woods but not burned. Oak Island, which is nearly "yewless," sustained a severe ground fire in 1943.

An estimate of the total biomass of yew on each of the islands may be of interest. It can be calculated by multiplying estimated percent yew cover (Table 2) by island size (Table 1) and dividing by the estimated total "acreage" of yew in the archipelago (note that this measure does not take into account plant height and vigor, however). If this is done it is found that Outer has 40% of the archipelago total "acreage" of yew, followed by Sand (21%), Cat and Otter (both 9%), Michigan (8%), and Ironwood (5%) Islands.

Along with yew, mountain maple (*Acer spicatum*) is often dominant in the understory, particularly on the more northerly islands or in bluff-top forests exposed to prevailing winds. Beaked hazelnut (*Corylus cornuta*), skunk currant (*Ribes glandulosum*), juneberries (*Amelanchier* spp.) and, on the larger islands (and smaller islands on the lee side of the Bayfield Peninsula [Basswood, Hermit, and Michigan]), fly honeysuckle (*Lonicera canadensis*) and bush-honeysuckle (*Diervilla lonicera*) are frequent.

Throughout the archipelago, the dominant herbs are wood ferns (*Dryopteris carthusiana* and *D. intermedia*), corn-lily (*Clintonia borealis*), Canada mayflower (*Maianthemum canadense*), starflower (*Trientalis borealis*), wild sarsaparilla (*Aralia nudicaulis*; Fig. 26), sweet and smooth white violets (*Viola blanda* and *V. macloskeyi*), rosy twisted-stalk (*Streptopus* 

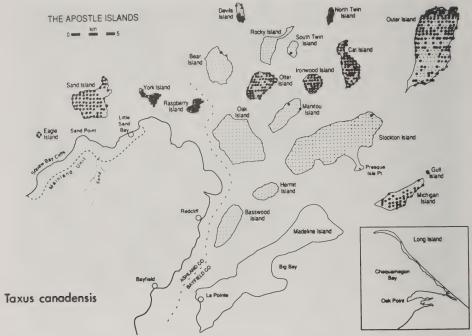


FIGURE 4. Distribution of Canada yew as a dominant understory plant. Dots show sample plots in which yew coverage was  $\geq 10\%$ .

roseus), bunchberry (Cornus canadensis), shining clubmoss (Lycopodium lucidulum), round-branched ground-pine (L. dendroideum), the sedges Carex arctata and C. brunnescens, sweet-scented bedstraw (Galium triflorum), and big-leaved aster (Aster macrophyllus). Widespread, fairly common species include wood anemone (Anemone quinquefolia), marsh blue violet (Viola cucullata), spikenard (Aralia racemosa), shinleaf (Pyrola elliptica), Carex communis, rattlesnake-plantains (Goodyera spp.), oak fern (Gymnocarpium dryopteris), long beech fern (Thelypteris phegopteris), running ground-pine (Lycopodium clavatum), wood-reedgrass (Cinna latifolia), spotted coral-root (Corallorhiza maculata), and Indian-pipes (Monotropa uniflora).

Because of the generally flat, poorly-drained clay soils, mesophytic herbs including spring ephemerals are not diverse or particularly common on the islands. They are most frequently found in the most well-drained sites on top of high clay bluffs on west coasts (as on Outer, Otter, and Rocky Islands) and are often associated with sugar maple, yellow birch, basswood, and hop-hornbeam. The most common mesic species encountered are nodding trillium (*Trillium cernuum*), jack-in-the-pulpit (*Arisaema triphyllum*), Chilean sweet cicely (*Osmorhiza chilensis*), dwarf ginseng (*Panax trifolius*), lady fern (*Athyrium angustum*), enchanter's-nightshade (*Circaea alpina*),

white mandarin (Streptopus amplexifolius), wood millet (Milium effusum), the sedge Carex leptonervia, and, on the larger islands, Solomon's-seal (Polygonatum pubescens), false Solomon's-seal (Smilacina racemosa), and wild oats (Uvularia sessilifolia). White baneberry (Actaea pachypoda), the sedge Carex scabrata, round-leaved hepatica (Hepatica americana), naked mitrewort (Mitella nuda), striped coral-root, black snakeroot, the grass Brachyelytrum erectum, yellow violet (Viola pubescens), round-leaved orchid (Platanthera orbiculata), and the true ephemerals Carolina springbeauty (Claytonia caroliniana) and yellow trout-lily (Erythronium americanum) are less commonly encountered, often only in ravine bottoms on the larger islands. Deep, moist ravines on Oak Island harbor two rare mesophytes, the drooping sedge (Carex prasina) and broad-lipped twayblade (Listera convallarioides). The latter species is also found in ravines at Little Sand Bay in the Lakeshore's Mainland Unit. Mesophytic shrubs, including pagoda and round-leaved dogwoods (Cornus alternifolia and C. rugosa), hairy honeysuckle (Lonicera hirsuta), and partridge-berry (Mitchella repens), are uncommon and mostly found on Madeline, Oak, Outer, and Stockton Islands.

## Boreal Forest and "Krumholtz"

A second upland forest community is present in the archipelago. Finley (1976) mapped boreal forest as occurring on all of North Twin, Raspberry, South Twin, York, and in parts of Madeline, Rocky (northeast peninsula), and Sand (western one-third and Lighthouse Point) Islands. He defined boreal forest as that in which white spruce (Picea glauca), balsam-fir, tamarack (Larix laricina), white cedar, white birch, and aspen were dominant species. However, while on the aforementioned islands balsam-fir and white birch are indeed common, white spruce is rare or absent. On the other hand, the northern two-thirds of Devils Island is classic boreal forest with white spruce as one of the dominants and *Usnea* spp. lichens festooning the trees (Fig. 15; see discussion under island summary). We consider this part of the island to be the only extensive (ca. 80 ha) example of boreal forest in the Lakeshore. Tiny fragments of boreal forest-like vegetation that can be more aptly compared to wind-shaped, stunted alpine "krumholtz" forests are found on the more exposed coasts of the northern islands (e.g., Devils Island, Figs. 11, and Outer Island, Fig. 20). These low forests feature a mix of white birch, balsam-fir, white cedar, and showy mountain-ash with a dense mountain maple or yew understory that is difficult to penetrate. Krumholtz is best-developed on Devils Island, where it occurs as a 10-30 m wide belt inland on coastal bluff tops except near the south tip. It is also found on the north tips of Bear, Cat, and North Twin Islands, and from the northeast tip of Outer Island (Austad Point) south to Lullaby Logging camp. Common understory associates are red baneberry (Actaea rubra), naked mitrewort, and the shrubs red-berried elder (Sambucus pubens) and Bartram's juneberry (Amelanchier bartramiana).

# Sandscapes

The sandscapes of the Apostle Islands are some of the most extensive and diverse on Lake Superior and have been the subject of numerous geomorphological and ecological studies (Bona 1990; Coffin 1977; Engstrom 1977, 1984, 1985; McEachern 1991; Jefferson 1976; Middleton 1979, 1983; Middleton & Schimpf 1986). Their presence is responsible for much of the floristic diversity of the islands. With the exceptions of small ones on the north or west sides of Madeline, South Twin, and Stockton Islands, they occur on the southern tips of islands due to the prevailing direction of longshore currents. The more inclusive term sandscape (instead of sand spit) is used in this paper because in the Apostles, these landforms have originated in a number of different ways. Thus, there are cuspate forelands (as on Raspberry and South Twin Islands), barrier beaches (Big Bay and Amnicon Bay on Madeline Island), tombolos (York Island), a double tombolo (Presque Isle Point on Stockton Island), beaches (Justice Bay on Sand Island), a barrier spit (Long Island), as well as true sand spits (Cat and Outer Islands). The following vegetational zones will be found on a typical sandscape (Nuhfer & Dalles 1987): a beach devoid of vegetation, active dunes, interdunal hollows (sometimes with ephemeral pools or ponds), stabilized dunes and/or beach ridges (sometimes covered with pine savannas or forests), and, often, a filled-in lake basin covered with bog or alder thicket vegetation.

Dunes. The dominant species on dune grassland is beach grass (Ammophila breviligulata; Fig. 5). Common associates are beach pea, beach wormwood (Artemisia campestris), false-heather (Hudsonia tomentosa), sand cherry (Prunus pumila), common juniper (Juniperus communis), common hairgrass (Deschampsia flexuosa), Canada wild-rye (Elymus canadensis), a fescue (Festuca saximontana), ticklegrass (Agrostis scabra), bastard-toadflax (Comandra umbellata), sand cress (Arabis lyrata), evening-primrose (Oenothera oakesiana), fireweed (Epilobium angustifolium), Canada goldenrod (Solidago canadensis), and roses, especially Rosa blanda (Fig. 6). On Long Island (Fig. 16), heart-leaved willow (Salix eriocephala) is dominant on dune crests; it is found on other sandscapes as well. Several other species including the sandbar (S. exigua) and slender (S. gracilis) willows are common on the dunes. Among non-vascular plants, lichen heaths are prominent on stabilized dunes on Long, Outer, Rocky, and Stockton (north and south ends of Julian Bay) Islands; the commonest species are the reindeer-mosses Cladina mitis (Sandst.) Hustich, C. rangiferina (L.) Nyl., Cladonia cristatella Tuck., and C. chlorophaea (Somm.) Sprengel (Middleton 1983, Wetmore 1990). On disturbed sandscapes such as Ironwood and Oak Islands, orange hawkweed (Hieracium aurantiacum), king-devil (H. piloselloides), Canada blue grass (Poa compressa), quack grass (Agropyron repens), sheep sorrel (Rumex acetosella), and red raspberry (Rubus strigosus) are frequent. Occasional native species include common milkweed (Asclepias syriaca), spreading dogbane (Apocynum androsaemifolium), slender wheat-grass (Agropyron trachycaulum),

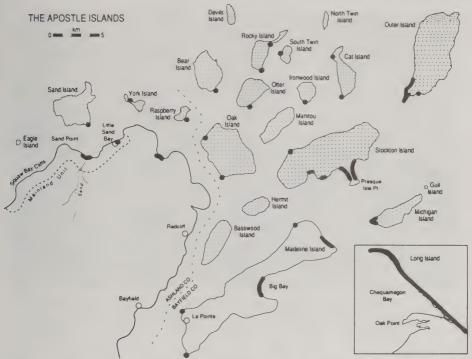


FIGURE 5. Distribution of beach grass (*Ammophila breviligulata*), a dominant species on all significant sand spits, cuspate forelands, and barrier and tombolo beaches. Note the predominance of occurrence on the southern ends of islands where sediment-bearing currents converge.

hairy goldenrod (Solidago hispida), jointweed, Carex rugosperma var. tonsa, and the horsetails Equisetum arvense and E. × ferrissii. Near docks and on sandscape shores, such weedy species as reed canary-grass (Phalaris arundinacea) and seedlings of box elder (Acer negundo) and green ash (Fraxinus pennsylvanica) are sometimes encountered. Could their propagules have fallen into boats parked in the owners' backyards?

Pine savanna and forest. Red pine (Pinus resinosa) and white pine stands often occur on the stabilized beach ridges and are best-developed on Long, Madeline, Michigan, Outer, and Stockton Islands and near the mouth of the Sand River in the Mainland Unit. Jack pines (P. banksiana) are less common and are present in large numbers only on Long Island. There is often a complete gradation from stabilized dunes to pine savanna to closed-canopy pine forest. Common pine savanna and forest understory species include wintergreen (Gaultheria procumbens), rough-leaved mountain-rice (Oryzopsis asperifolia), O. pungens, wild sarsaparilla, pink lady's-slipper (Cypripedium acaule), bristly sarsaparilla (Aralia hispida), pipsissewa (Chimaphila umbellata), bracken fern (Pteridium aquilinium), bushhoneysuckle, bunchberry, cow-wheat (Melampyrum lineare), bearberry



FIGURE 6. View east over dune grassland with common juniper (*Juniperus communis*), sand cherry (*Prunus pumila*), common hairgrass (*Deschampsia flexuosa*), and *Festuca saximontana* on Outer Island sand spit. White pine savanna in background, 30 June 1990.

(Arctostaphylos uva-ursi), one-sided pyrola (Pyrola secunda), shinleaf, twinflower (Linnaea borealis), Canada hawkweed (Hieracium kalmii), and lowbush blueberry (Vaccinium angustifolium). Huckleberry (Gaylussacia baccata), slightly disjunct from the bulk of its range farther south, is common under pines on Big Bay barrier beach on Madeline Island and Presque Isle Bay on Stockton Island.

Bogs. Bogs dominated by sedges, ericads, and Sphagnum spp. mosses often occur in the filled-in lake basins that occur just inland from sandscape dune ridges (Fig. 7). Scattered trees of tamarack, black spruce (Picea mariana), white pine, and white birch occur, and the commonest shrubs are sweet gale (Myrica gale), leatherleaf (Chamaedaphne calyculata), Labrador-tea (Ledum groenlandicum), bog-laurel (Kalmia polifolia), velvet-leafed blueberry (Vaccinium myrtilloides), creeping snowberry (Gaultheria hispidula), cranberries (Vaccinium macrocarpon and V. oxycoccos), and bog and balsam willows (Salix pedicellaris and S. pyrifolia). Winterberry holly (Ilex verticillata) and mountain-holly (Nemopanthus mucronatus) are found in the shrub layer on the larger islands. The most frequent herbs are calla-lily (Calla palustris), three-leaved false Solomon'sseal (Smilacina trifolia), buckbean (Menyanthes trifoliata), bog goldenrod (Solidago uliginosa), marsh St. John's-wort (Triadenum fraseri), blue flag (Iris versicolor), dragonmouth (Arethusa bulbosa), grass-pink (Calopogon tuberosus), rose pogonia (Pogonia ophioglossoides), club-spur orchid (Pla-



FIGURE 7. Air photograph of southeastern tip of Rocky Island. Note open dunes (3 ha) and the enclosed, open sphagnum-sedge bog (2 ha). The conifers fringing the bog are balsam-fir (left) and white pine (right). The inland, upland forest is principally red maple, yellow birch, and white birch, 26 October 1984.

tanthera clavellata), pitcher-plant (Sarracenia purpurea), and round-leaved sundew (Drosera rotundifolia). Sedges are numerous and include Carex canescens, C. disperma, C. echinata, C. lacustris, C. lasiocarpa, C. limosa, C. oligosperma, C. paupercula, C. rostrata, and C. trisperma. Cottongrasses (especially Eriophorum spissum and E. virginicum) and white and sooty beak-rushes (Rhynchospora alba and R. fusca) are also frequent. The larger bogs on Madeline, Michigan (Fig. 8), Outer, and Stockton Islands have lagoons with floating and submersed aquatic species such as watershield (Brasenia schreberi), yellow pond-lily (Nuphar luteum), white waterlily (Nymphaea odorata), pondweeds (Potamogeton spp.), swaying bulrush (Scirpus subterminalis), and bladderworts (Utricularia intermedia and U. vulgaris). Wet, sandy-peaty interdunal hollows (e.g., Stockton Island, Fig. 22) have twig-rush (Cladium mariscoides), three-way sedge (Dulichium arundinaceum), many true rushes (Juncus alpinoarticulatus, J. balticus, J. canadensis, J. brevicaudatus, and J. pelocarpus), pipewort (Eriocaulon septangulare), and horned bladderwort (Utricularia cornuta).

Bogs are also found on the poorly-drained summit plateaus of many of the islands, especially on Bear, Devils (Fig. 9), and Otter Islands, but also on Devils and Sand Islands. These interior wetlands are often smaller and have poorer bog florulas than their coastal, sandscape counterparts, but all of the common ericads and insectivores are usually present. Outer Island and especially eastern Stockton Island each has several of these "perched" bogs, which are discussed in more detail in the island-by-island summaries.



FIGURE 8. View east over bog lagoon (ca. 1 ha) just inland from sand spit on western end of Michigan Island; note beaver lodge on left. The floating aquatics water-shield (*Brasenia schreberi*) and yellow pond-lily (*Nuphar luteum*) are common cat-tails (*Typha latifolia*) are in the foreground, 28 July 1992.

Even the smaller islands have a tendency to have at least a small boggy patch in the woods at their flat summits, for example the northern peninsula of Cat Island and the western peninsula of York Island.

# Alder Thickets and Beaver Flowages

Wetlands dominated by thickets of speckled alder (Alnus incana subsp. rugosa) are frequent on the Apostle Islands in a number of habitats. These very wet communities fringe sandscape bogs, beaver flowages, and old roads. Blue-joint (Calamagrostis canadensis) is a common associate. Frequent understory shrubs are skunk and swamp red (Ribes triste) currants; the most common herbs are spotted touch-me-not (Impatiens capensis), swamp cinquefoil (Potentilla palustris), vellow and tufted loosestrifes (Lysimachia terrestris and L. thyrsiflora), northern bugleweed (Lycopus uniflorus), common and mad-dog skullcaps (Scutellaria galericulata and S. lateriflora), marsh-marigold (Caltha palustris), sedges (Carex crinita, C. intumescens, C. lacustris, C. stipata, C. trisperma, and C. vesicaria), fowl meadow-grass (Poa palustris), tussock sedge (Carex stricta), great water dock (Rumex orbiculatus), northern and purple-leaved willow-herbs (Epilobium ciliatum and E. coloratum), sticktights (Bidens spp.), water-parsnip (Sium suave), tall and early meadow-rues (Thalictrum dasycarpum and T. dioicum), rattlesnake-grass (Glyceria canadensis), fowl meadow-grass (G.



FIGURE 9. Perched bog (3 ha) at poorly-drained summit of Devils Island. Dominant trees are tamarack, white pine, and black spruce. Dominant shrubs are Labrador tea (*Ledum groenlandicum*), and leatherleaf (*Chamaedaphne calyculata*), 22 June 1991.

striata), bedstraws (Galium tinctorium and G. trifidum), water-hemlocks (Cicuta bulbifera and C. maculata), blue flag, and purple-stemmed aster (Aster puniceus). Many of these same species along with yellow cress (Rorippa islandica), joe-pye weed (Eupatorium maculatum), water starwort (Callitriche verna), Torrey's manna-grass (Torreyochloa pallida), and spikerush (Eleocharis obtusa) can be found near the numerous old beaver flowages on Madeline, Michigan (Fig. 17), Outer, and Stockton Islands.

# Clayscapes

Steep, reddish clay bluffs occur on all of the islands and in total account for over half of the archipelago's 300 km of coastline. These "clayscapes" are best developed on the northwestern tip of Oak Island, nearly all of Michigan Island, and on the western sides of Bear, Otter, Rocky (Fig. 21), Cat, and Outer Islands. This distinctive, dynamic community is poorlystudied, at least in Wisconsin. The eroding slopes are vegetated with small trees of balsam-poplar (Populus balsamifera), white birch, red maple, and showy mountain-ash. White cedar and balsam-fir are often present, but the bulk of the woody vegetation are the shrubs speckled alder, green alder (Alnus viridis subsp. crispa), willows (Salix bebbiana, S. discolor, S. gracilis, and S. humilis), red raspberry, juneberries (Amelanchier spp.), red-osier dogwood (Cornus stolonifera), and bush-honeysuckle. Both native and exotic herbs are frequent and include Canada wild-rye, Canada blue grass, Poa nemoralis, wedge-grass (Sphenopholis obtusata), Carex foenea, C. projecta, C. scoparia, fringed false buckwheat (Polygonum cilinode), mouse-ear chickweed (Cerastium fontanum), long-leaved stitchwort (Stellaria longifolia), wild strawberry (Fragaria virginiana), red and white clovers (Trifolium pratense and T. repens), fireweed, evening-primrose, yarrow (Achillea millefolium), pearly everlasting (Anaphalis margaritacea), Canada and bull thistles (Cirsium arvense and C. vulgare), daisy fleabane (Erigeron strigosus), orange hawkweed, blue lettuce (Lactuca biennis), horseweed (Conyza canadensis), ox-eye daisy (Chrysanthemum leucanthemum), Canada goldenrod, panicled aster (Aster lanceolatus), smooth sow-thistle (Sonchus uliginosus), and common dandelion (Taraxacum officinale). Less common but characteristic of wet, seeping areas are golden and Houghton's sedges (Carex aurea and C. houghtoniana) and tall northern green orchid (Platanthera hyperborea). Rare species in this habitat include marsh grassof-parnassus (Parnassia palustris) and (possibly) Mingan moonwort (Botrychium minganense) on northern Outer island, and plains ragwort (Senecio indecorus) on northern Rocky Island.

# Rockscapes

About a third of the Apostle Islands' coast consists of pre-Cambrian sandstone ledges and bluffs. The local vegetation of these rock faces depends on their height, slope, aspect, extent of seepage, and rate of erosion. On flat, low, shelving, often wave-splashed ledges the commonest



FIGURE 10. Broad, flat sandstone ledges at nearly lake level on the southeastern coast of Outer Island (NW1/4, Sec. 12). Common species include grass-leaved goldenrod (Euthamia graminifolia), meadowsweet (Spiraea alba), ticklegrass (Agrostis scabra), harebell (Campanula rotundifolia), three-toothed cinquefoil (Potentilla tridentata), wild strawberry (Fragaria virginiana), and willows (Salix bebbiana and S. humilis); the calciphilic brook lobelia (Lobelia kalmiii) is occasional, 30 July 1992.

woody species are willows (Salix bebbiana, S. discolor, and S. humilis). The rare sating and flat-leaved willows (S. pellita and S. planifolia) are also found in this habitat. Alders, balsam-poplar, red-osier dogwood, and showy mountain-ash are also common. The most frequent herbaceous species (Fig. 10) are fireweed, wild strawberry, blue grasses (Poa compressa and P. nemoralis), ticklegrass, wedge-grass, stitchwort (Stellaria borealis), smooth white violet, willow-herbs, yarrow, pearly everlasting, horseweed, daisy fleabane, Canada goldenrod, plains ragwort (on North Twin and Outer Islands), and common dandelion. Not surprisingly, many of these species are weedy ones also found on clay bluffs and in clearings. Ledges on some islands may be slightly calcareous, because they harbor the following species with calciphilic tendencies: bird's-eye primrose, harebell (Campanula rotundifolia), brook lobelia (Lobelia kalmii), grass-leaved goldenrod (Euthamia graminifolia), ninebark (Physocarpus opulifolius), meadowsweet (Spiraea alba), wood strawberry (Fragaria vesca), threetoothed cinquefoil (Potentilla tridentata), Scirpus hudsonianus, and Carex viridula. These calcareous habitats, if such they be, occur on the following islands: Cat (southeastern coast), Devils (Devils Island Formation, northern



FIGURE 11. Pre-Cambrian sandstone cliffs about 6 m high on western side of north tip of Devils Island. Butterwort (*Pinguicula vulgaris*) and bird's-eye primrose (*Primula mistassinica*) grow near the cliff tops on shelves and moist, shaded vertical faces. Note the stunted "krumholtz" bluff-top forest of white birch, white cedar, balsam-fir, and showy mountain-ash, with blooming Labrador-tea (*Ledum groenlandicum*) in lower right, 22 June 1991.

tip; Fig. 11), Manitou (northeastern tip), Oak (southeastern tip), Outer (eastern coast), Sand (Lighthouse Point, on Orienta Formation sandstone), York (northern coast), and especially at Presque Isle Point on Stockton Island, where the calciphilic sedges Carex buxbaumii and C. diandra also occur. Near wave-splashed rock pools, bog elements like sweet gale, balsam willow, blue-joint, wool-grass (Scirpus cyperinus), the rush Juncus brevicaudatus, the St. John's-wort Hypericum majus, and the rare shore sedge (Carex lenticularis) are also sometimes found, as well as pteridophytes such as cinnamon and interrupted ferns (Osmunda cinnamomea and O. claytoniana) and sensitive fern (Onoclea sensibilis). Subarctic rarities occur mostly on north-facing cliffs moistened by seepage on Devils, Ironwood, Otter, and Outer Islands and include butterwort, bird's-eye primrose, spike trisetum (Trisetum spicatum; Fig. 25), hair-like sedge (Carex capillaris), and beautiful sedge (C. concinna). Shaded bluffs may also harbor spikenard and pteridophytes such as common polypody (Polypodium virginianum), long beech fern, oak fern, fragile ferns (Cystopteris fragilis, C. ×laurentiana, and C. tenuis), and, rarely, Lycopodium × buttersii, a hybrid of shining and fir clubmosses (L. lucidulum and L. selago).

#### Disturbed Areas

Old clearings that have reverted to forest can often be identified by the otherwise uncommon pteridophytes persisting in the understory, including rattlesnake fern (Botrychium virginianum), leathery grape-fern (B. multifidum), matricary grape-fern (B. matricariifolium), and ground-cedar (Lycopodium digitatum). Muddy, rutted, overgrown logging roads, often barricaded by fallen trunks of aspen or pin cherry (Prunus pensylvanica), occur most frequently on the outer islands. They often have dense growths of pteridophytes including woodland horestail (Equisetum sylvaticum), cinnamon fern, interrupted fern, sensitive fern, and ostrich fern (Matteuccia struthiopteris). Spotted touch-me-not, water-pepper (Polygonum hydropiper), wool-grass, Carex crinita, C. stipata, and mad-dog skullcap are also frequent in this disappearing microhabitat. Younger clearings (cover photograph) are often dominated by Kentucky blue grass (Poa pratensis), common buttercup (Ranunculus acris), and orange hawkweed, and have as associates redtop (Agrostis stolonifera), orchard grass (Dactylis glomerata), quack grass, timothy (Phleum pratense), reed canary-grass (Phalaris arundinacea), blue-eyed grass (Sisyrinchium montanum; native), sheep sorrel, mouse-ear chickweed, sweet william (Dianthus barbatus), white campion (Silene latifolia subsp. alba), agrimony (Agrimonia striata), yellow rocket (Barbarea vulgaris), yellow avens (Geum aleppicum), rough cinquefoil (Potentilla norvegica), clovers (Trifolium aureum, T. hybridum, T. pratense, and T. repens), common St. John's-wort (Hypericum perforatum), hemp-nettle (Galeopsis tetrahit), self-heal (Prunella vulgaris), wild basil (Satureja vulgaris), plantains (Plantago lanceolata and P. major), common burdock (Arctium minus), king-devil, ox-eye daisy, and common dandelion. Annual blue grass (Poa annua) and thyme-leaved speedwell (Veronica serpyllifolia) are common in muddy trodden paths. Older, overgrown "log rolls" and clearings, such as those on the western and northern coasts of Stockton Island, are often dominated by thickets of the tall native herbs figwort (Scrophularia lanceolata), cow-parsnip (Heracleum lanatum), fireweed, and the shrub thimbleberry (Rubus parviflorus), with few remaining smaller associates, and, often, invading aspens and white birches. Longabandoned farmsites such as the ones on Basswood, Hermit, and Sand Islands, and the Outer and South Twin Island airstrips, often have interesting native invaders such as ragged fringed orchid (Platanthera lacera) and northern bedstraw (Galium boreale), as well as persistent introductions like old apple (Pyrus malus) orchards. Finally, one of the most intriguing species in the Lakeshore is the presumably exotic heath rush (Juncus squarrosus) which is found in North America only on Devils Island (see discussion there and under species entry) and in Greenland.

## FLORISTICS AND BIOGEOGRAPHY

The Apostle Islands are floristically rich when compared with other coastal Lake Superior areas. The flora of 793 island species and hybrids represents over one-third of Wisconsin's flora and is significantly richer than Isle Royale (703 species, Slavick & Janke 1987), which is more than twice as large. Pictured Rocks National Lakeshore is slightly smaller than the Apostle Islands National Lakeshore and has 572 species (Read 1975).

Nine vascular plant species found nowhere else in Wisconsin occur in the Apostles: three previously reported native herbs (butterwort, plains ragwort, and woodland cudweed [Gnaphalium sylvaticum]); a pair of native willows (Salix pellita and S. planifolia); and four presumably introduced species, one European (Carex ovalis), two North American (Carex tincta and Crataegus douglasii) and one known in Europe and Greenland (Juncus squarrosus). In addition, 37 rare (Wisconsin Department of Natural Resources 1993; Table 3) species occur on the islands (Judziewicz 1993).

Rugged Oak Island, with its south-facing slopes and deep ravines, may have served as a refugium for several plants that may be relicts of the warm, post-glacial, "Xerothermic" period of about 3,500 B.P., when species often grew 65-95 km north of their present-day ranges (Curtis 1971; p. 450-455). Carex prasina, C. scabrata, yellow wild licorice (Galium lanceolatum), witch-hazel (Hamamelis virginiana), and squaw-root (Conopholis americana) are all at their northwesternmost range limits on Oak Island, and their nearest stations are several dozen to over 160 (Carex prasina; Fig. 24) km to the south.

It is interesting to enumerate common "continental" species that are absent from the islands, and speculate on possible reasons for their absence. Many mesophytic species that are at least locally common on the Wisconsin mainland in Ashland and Bayfield Counties do not occur on the islands. Dutchman's-breeches (Dicentra cucullaria) and bloodroot (Sanguinaria canadensis) are extremely rare on the islands and were not noted in this study, while wild ginger (Asarum canadense L.), large-flowered bellwort (Uvularia grandiflora Smith), blue cohosh (Caulophyllum thalictroides (L.) Michaux), toothwort (Dentaria lacinata Willd.), bishop's-cap (Mitella diphylla L.), Canada violet (Viola canadensis L.), fringed milkwort (Polygala paucifolia Willd.), great-flowered trillium (Trillium grandiflorum (Michaux) Salisb.), and wild leek (Allium tricoccum Aiton) were not found at all. Many of these taxa are myrmechorous (ant-dispersed), and this symbiosis may limit their distribution; if a particular ant species is absent, the plant will be, too. Also, the heavy clay soils of the islands may lack the nutrients and proper moisture-holding qualities to support these mesic species, factors that might also help explain the absence of boreal mesophytes such as Braun's holly-fern (Polystichum braunii (Spenner) Fée; Penokee Range ravines in Ashland and Iron Counties) and tall lungwort (Mertensia paniculata (Aiton) G. Don; mainland ravines on the Bayfield Peninsula). The absence of deer on most of the islands may be a factor in preventing the spread there of common epizoochorous (externally animal dispersed) mainTABLE 3. Vascular plants occurring in the Apostle Islands National Lakeshore and Madeline Island that are listed by the Wisconsin Department of Natural Resources (1993) as of "special concern" (Group A), threatened (Group B), or endangered (Group C); Group D includes species that, in the authors' opinions, should be considered for listing.

#### GROUP A

Arethusa bulbosa

Botrychium lanceolatum

Botrychium minganense

Botrychium simplex

Calamagrostis inexpansa

Carex capillaris

Carex pallescens

Carex tenuiflora (Madeline Island only; not noted in this study)

Deschampsia cespitosa

Deschampsia flexuosa

Dryopteris expansa

Eleocharis robbinsii

Equisetum palustre

Equisetum variegatum

Gnaphalium sylvaticum (perhaps extirpated; not noted in this study)

Lycopodium selago

Ophioglossum pusillum (as O. vulgatum on Wisconsin D.N.R. list; not noted in this study)

Osmorhiza chilensis

Platanthera dilatata (perhaps extirpated; not noted in this study)

Platanthera orbiculata

Primula mistassinica

Rhynchospora fusca

Senecio indecorus

Utricularia resupinata

#### **GROUP B**

Calypso bulbosa (Mainland Unit only; perhaps extirpated, not noted in this study)

Carex concinna

Carex exilis

Carex lenticularis

Carex michauxiana

Carex prasina

Drosera linearis (Madeline Island only; not noted in this study)

Listera convallarioides

Parnassia palustris

Trisetum spicatum

#### **GROUP C**

Armoracia lacustris (as A. aquatica on Wisconsin D.N.R. list)

Botrychium lunaria (not noted in this study)

Pinguicula vulgaris

#### GROUP D

Salix pellita

Salix planifolia

land species such as stickseed (Hackelia deflexa (Wahlenb.) Opiz) and northern comfrey (Cynoglossum boreale Fern.).

The petrophilic (rock-loving) fern flora of the Apostles is also depauperate. Spleenworts (Asplenium spp.), rock-brakes (Cryptogramma spp.), fragrant wood fern (Dryopteris fragrans (L.) Schott), and woodsias (Woodsia spp.), are all absent from the islands' sandstone cliffs, and the record of slender lip-fern (Cheilanthes feei) is highly questionable. The lack of basic substrates may be a factor, because most of these taxa are found on the basaltic rocks on the Minnesota shore of Lake Superior. Other calciphiles locally present along the Wisconsin shore of Lake Superior but absent from the Apostles are the shrubs soapberry (Shepherdia canadensis (L.) Nutt.) and shrubby cinquefoil (Potentilla fruticosa L.).

Turning to xeric habitats, it is noteworthy that the sandscapes of the Apostles have no prairie or jack pine barrens elements in their florulas. Even big bluestem (Andropogon gerardii Vitman) and sweet fern (Comptonia peregrina (L.) Coulter), common in the sandy Moquah Barrens country of the interior Bayfield Peninsula southwest of the archipelago, are absent.

The far-northern component of the flora is not large. Of 48 species listed by Given and Soper (1981) as constituting the arctic-alpine floristic element of the Lake Superior basin, only five are found in the Lakeshore: spike trisetum, fir clubmoss, hair-like sedge, butterwort, and bird's-eye primrose. This is low in comparison with more northerly coastal areas of Lake Superior such as Isle Royale National Park, the Keweenaw Peninsula, the Minnesota shore, and north shore areas of Ontario (Table 4). However, the Apostles' arctic-alpine component does compare favorably with south shore florulas such as those of the Huron Mountains and Pictured Rocks National Lakeshore in Michigan. Given and Soper (1981) presented a map suggesting that mid-summer surface temperatures of Lake Superior may be an important factor in delimiting arctic-alpine microhabitats. The Apostles also have the only Wisconsin stations for the sub-arctic (which for some reason are not listed as arctic-alpine elements by Given and Soper) willows Salix pellita and S. planifolia, which are present but not common in northern Michigan and Minnesota, and woodland cudweed, found west to northern Michigan and collected once on Outer Island (Freckmann & Fraundorf

Compared with other Lake Superior areas, especially the Keweenaw Peninsula, the Apostles do not have a rich Western Cordilleran disjunct (Marquis & Voss 1981) element in their flora, either. Only thimbleberry, Chilean sweet cicely, and green-leaved rattlesnake-plantain (Goodyera oblongifolia) are present, although white mandarin and striped coral-root (Corallorhiza striata) might also be considered as Cordilleran disjuncts by some. It is interesting to note that the Huron Mountains and Pictured Rocks National Lakeshore, also on the south shore of Lake Superior, both have 11 Cordilleran disjunct species, compared with only three for the Apostles (Table 4).

Guire and Voss (1963) discussed the distinctive shoreline plants of the Great Lakes. Besides the ubiquitous beach grass and beach pea, only a few

TABLE 4. Arctic-alpine (\*-based on 48 species; Given & Soper 1981) and Western Cordilleran (\*\*-based on 28 species; Marquis & Voss 1981) elements in Lake Superior shoreline regional floras.

Region	Arctic-alpine species*	Western cordilleran species**
Apostle Islands National Lakeshore, Wisconsin (this study)	5	3
Huron Mountains, Michigan (Wells & Thompson 1976)	4	11
Isle Royale National Park Michigan (Slavick & Janke 1987)	21	11
Keweenaw County, Michigan (Wells & Thompson 1974)	19	19
Lake Superior Provincial Park, Ontario (Brunton 1991)	12	6
Michipicoten Island, Ontario (Given & Soper 1981)	14	6
Minnesota shore of Lake Superior (Ownbey & Morley 1991)	18	4
Pictured Rocks National Lakeshore Michigan (Read 1975)	8	10
Pukaskwa National Park, Ontario (Environment Canada Parks Service, no date)	23	5
Sibley Peninsula, Ontario (Given & Soper 1981)	27	10
Slate Islands, Ontario (Given & Soper 1981)	23	3

of these such as blueleaf willow (Salix myricoides) and bugseed (Corispermum hyssopifolium)—both rare—are present in the Apostles. This is probably due in part to the paucity of lake sandscapes in this part of the Midwest. Aside from the Apostles, the only sandscapes in the far western Lake Superior region are small barrier beaches along the Wisconsin shore in Bayfield County (near Port Wing, Cornucopia, and Raspberry Bay), and the large Duluth-Superior barrier spits.

The larger bogs on Madeline, Outer, and Stockton Islands show strong affinities with a series of coastal bogs found behind barrier beaches on the northern shore of the Bayfield Peninsula from Port Wing to Raspberry Bay (including the Sand River and Little Sand Bay bogs in the Mainland Unit of the Lakeshore), and the Sand Cut Slough bog at the base of the Chequamegon Peninsula. These are apparently some of the only coastal bogs on western Lake Superior from the Canadian border to the Keweenaw Peninsula. The richest of these, at Bark and Raspberry Bays, have such Wisconsin rarities (Tans 1983) as dragonmouth, sooty beak-rush, and Michaux's sedge, as well as several species not found on the islands such as bog arrowgrass (*Triglochin maritima* L.), alder-leaved buckthorn (*Rhamnus alnifolia* L'Her.), and *Carex livida* (Wahlenb.) Willd.

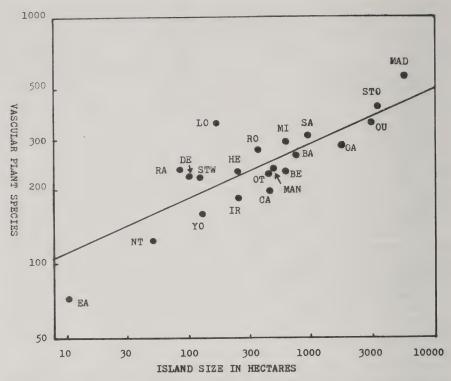


FIGURE 12. Native vascular plant species/area curve for the Apostle Islands, with least-squares fitted regression line.

Analysis of the Apostles' flora in terms of island biogegraphical theory will be detailed in a future paper, but we do present the log-transformed species/area curve and fitted regression line for the native flora (Fig. 12). MacArthur and Wilson (1967) predicted that, for a variety of reasons, immigration rates will be lower and extinction rates higher on islands than on continental areas, resulting in a species/area curve whose y-intercept (when log-transformed to a straight line) will be lower, and slope steeper. The fitted regression line for the Apostles follows the formula  $S = 53.6 \times A^{0.249}$ , where S is the number of vascular plant species (both native and alien) and A island size in hectares. This compares reasonably closely with  $S = 62 \times A^{0.301}$  for the floras of 41 islands in a Swedish lake (Nilsson & Nilsson 1978), and conforms well to MacArthur and Wilson's (1967) prediction of an exponent in the range of 0.20–0.35 for island biotas, compared with 0.12–0.17 for continental areas.

It is interesting to consider the distribution of "rich" (Fig. 13) versus "poor" (Fig. 14) 0.01 hectare sample plots throughout the archipelago. The larger islands plus the smaller islands on the protected, lee-side of the Bay-

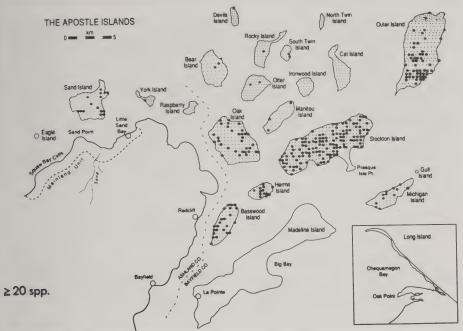


FIGURE 13. Distribution of floristically rich sampling plots (≥ 20 species of vascular plants/0.01 ha).

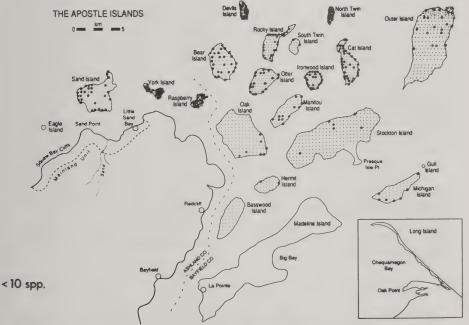


FIGURE 14. Distribution of floristically poor sampling plots (< 10 species of vascular plants/0.01 ha).

field Peninsula (Basswood, Hermit, and Michigan) have richer sample plot florulas than those of the generally smaller islands in the more remote "northwestern arc" of the archipelago, which are more exposed to winter storms and prevailing winds. There is also an obvious negative correlation between plot richness and Canada yew abundance (Table 2; Fig. 4). There is an obvious concentration of poor plots on the bluff-top perimeters of Bear, Cat, Ironwood, Otter, and Rocky Islands that may be related to the abundance of windfalls and balsam-fir thickets in these exposed sites. Finally, the higher plot diversity of the small, lee-side islands may also be correlated with their more intensive human exploitation (quarrying, farming, logging, and fires) due to their proximity to the ports of Bayfield, Washburn, and Ashland.

### ISLAND-BY-ISLAND SUMMARIES

The following summaries give an impression of the flora and vegetation of each island within the context of its unique physiography and human history. Statistics on island geography (including area, maximum elevation above Lake Superior, and distance from the mainland; Table 1) and floristics (including Canada yew dominance; Table 2) are generally not repeated below. Statements on the pre-settlement vegetation are based on tree diameters recorded in the General Land Office Survey for the years 1852-1857 (Frederick & Rakestraw 1976, Brander 1978). Lidfors (1984) and Frederick and Rakestraw (1976) were consulted for logging era history, and "irruption-era" (1953-1964) deer densities were calculated from the Wisconsin Department of Natural Resources harvest data summarized by Brander and Bailey (1983), who also summarized much other natural history data. Some information on human history is drawn from Burnham (1929), Ross (1951, 1960), Holzhueter (1974), and Harris (1976). Statements on current vegetation are drawn from recent (1970's-present) individual ecological studies (cited for each island) and from the senior author's own unpublished sampling plot data. Generally, trees, shrubs, and herbs are listed for each island in order of dominance as determined by Judziewicz's data. Swain (1986) cored numerous large trees throughout the archipelago in an attempt to reconstruct the history of the island forests, and his report was freely drawn upon in the following narratives. For geology, the excellent work of Nuhfer and Dalles (1987) was consulted for each island. Sandscape data is drawn from Middleton (1983), Engstrom (1977, 1984, 1985), and the unpublished monitoring surveys of J. F. Van Stappen and T. Doolittle made from 1988-1992.

#### Basswood Island

Basswood is a narrowly elliptical island that rises rather abruptly, especially on the west coast, to a domed central plateau. The flora is only moderately diverse (268 species) and probably reflects the lack of bogs and

sandscapes. The western coast, which lies close to the lee shore of the Bayfield Peninsula, slopes gradually to the water and clay bluffs are not well-developed. The eastern coast has both low clay bluffs, and, towards the northeast, low sandstone ledges and cliffs which culminate in Floating Rock; spike trisetum has been collected from ledges east of McCloud Farm. The southern tip has campsites among the bluff-edge red oaks, red pines, and white pines, under which grow bearberry, cow-wheat, three-toothed cinquefoil, and blueberries.

Basswood Island's pre-settlement forest was among the most diverse in the archipelago. Hemlock dominated, along with some large coastal white pines near the north and south ends of the island, but red oak, white birch, sugar maple, balsam-fir, white cedar, basswood, aspen, and red maple were also important. Logging began in the 1860's or 1880's and continued episodically until the 1950's; the forest in the northern half appears to be youngest (Swain 1986) and is dominated by sugar maple and white birch. Presently (Brander et al. 1978, Anderson et al. 1983) most of Basswood Island is dominated by the hardwoods sugar maple, white birch, red maple, and red oak, with smaller amounts of balsam-fir, quaking aspen (near the coast and in clearings), and relict hemlock groves. Red oak, with white birch, basswood, and hop-hornbeam as frequent associates, is common near the south tip.

It is easy to walk through the forest, which has a sparse understory of mountain maple, beaked hazelnut, and fly honeysuckle. Thimbleberry is common but declining in clearings and open woods near the coasts. Canada yew is rare (< 0.1% cover), since irruption-era deer populations were moderately high (4.8 killed/mi²/year). A resident herd still occurs (Brander & Bailey 1983, Anderson et al. 1985) with the 1981 population estimated to be 24 animals, or 3.0/mi². Both deer and bear signs were seen frequently during the present survey. The diverse herblayer is dominated by starflower, Canada mayflower, big-leaved aster, rosy twisted-stalk, wild sarsaparilla, bracken fern, and corn-lily; well-drained upland woods have Solomon's-seal and wild oats, while maidenhair fern (rare), black snakeroot, white mandarin, American brooklime, and golden ragwort (Senecio aureus) are encountered in the steep, short ravines on the east and west coasts.

Basswood Island has several farmsites, the oldest dating from 1865. Most prominent are the Rudd Farm (NW¹/4 of NE¹/4, Sec. 33) and the McCloud/Brigham Farm (S¹/2 of SW¹/4, Sec. 27), abandoned about 50 years ago. Both are quickly being reclaimed by trees, but have native and introduced species uncommon elsewhere in the archipelago, including showy tick-trefoil (*Desmodium canadense*), northern bedstraw, ragged fringed orchid, hairy vetch (*Vicia villosa*), black-eyed susan (*Rudbeckia hirta*), and in the surrounding woods, many green ash trees. Relicts of cultivation at the McCloud site include apple and plum (*Prunus americana*) trees, rhubarb (*Rheum rhabarbarum*), horseradish (*Armoracia rusticana*), red currant (*Ribes rubrum*), and costmary (*Chrysanthemum balsamita*). B. A. Middleton (1979 notes) also saw prickly-ash (*Zanthoxylum americanum* Miller) and grapes (*Vitis* sp.) here, but these were not relocated in 1992.

Two old quarries are located on the far southeastern coast. One, operated by the Bass Island Brownstone Co. from 1868 to the mid-1890's, provided stone for many Midwestern buildings including the Milwaukee County Courthouse. The old lumber camp clearing on the west coast has a dock and campsites; a loop trail connects these to the McCloud Farm site, quarry, and south tip campsites, passing through several scenic hemlock groves, particularly one about a mile northeast of the dock.

### Bear Island

Bear Island is difficult to visit. The southern and eastern coasts are high, eroded clay bluffs (background, cover photograph) while the northern and western coasts feature rugged, pine-fringed sandstone cliffs and ledges, some with populations of spike trisetum. The north tip has a stunted, nearly impenetrable krumholtz forest due to the prevailing winter winds.

The pre-settlement forest was fairly diverse. The flat, clayey, poorlydrained northern half of the island was dominated by hemlock, white cedar, white pine, and yellow birch. In the better-drained, drumlinoid southern half hemlock, red oak, white and yellow birch, and especially sugar maple (Finley 1976) were more important. Larsen (1975), Bliss et al. (1980), and Swain (1986) have all studied the vegatative history and present cover. Logging was intensive, especially in the years preceeding World War II, but continuing into the 1950's. The northern half is now dominated by polesized white cedar, white and yellow birch, and balsam-fir, while the southern half is dominated by sugar maple, white birch, red maple, and some red oak; on the summit is a nearly pure sugar maple stand with a dense undergrowth of seedlings and saplings and few other species. On the slopes to the north and east of the summit bog (see below) is a small (ca. 15 ha), teardrop-shaped, uncut stand of large hemlock-hardwoods estimated to have originated around 1700 A.D. (Swain 1986). Apart from the stand west of Outer Island light, this is the finest remnant of this community in the archipelago.

Canada yew is not dominant on Bear Island; irruption-era deer densities were high (6.9 killed/mi²/year). Mountain maple is common, especially in the north, and, together with numerous fallen cedar and fir logs, makes travel difficult near the coasts. Reflecting the relatively impoverished total flora (235 species), the groundlayer is not very diverse. The most common species are wood ferns, corn-lily, starflower, and Canada mayflower. Common false Solomon's-seal, lady fern, wood millet, and nodding trillium are found in well-drained southwest coast bluff-top forests, but Larsen's (1975) report of the mesic herbs Solomon's-seal and Carolina spring-beauty could not be confirmed.

Of the many perched bogs in the Apostle Islands surely the most noteworthy is the 2 ha "summit crater" on this island. Located on the 800 foot contour and surrounded by a 5,600-9,500 year old beach ridge (Kowalski 1976), this sphagnous bog has scattered trees of white pine, black spruce, and tamarack along with the usual (through depauperate) complement of

round-leaved sundew, pitcher-plant, bog ericads, and sedges, especially Carex utriculata.

A 2 ha cuspate foreland occurs on the south end of the island. It has experienced considerable human disturbance, and several privately-held cabins remain. Here a stand of red pine occurs with an understory of blueberries, Canada hawkweed, bearberry, pipsissewa, and the grass *Oryzopsis pungens*. The dune on the east side is dominated by beach grass and beach pea, with beach wormwood, common hairgrass, bastard-toadflax, and evening-primrose also present. On the west side of the foreland is a small, springy swamp with many characteristic alder thicket species. The northeast cove (SW¹/4 of SW¹/4, Sec. 28) has a sand beach about 300 m long, also with several beach species.

Disturbed areas with weedy species include the vicinity of the sandscape cabins; the abandoned logging camp located 400 m inland from the northeast cove (NW<sup>1</sup>/<sub>4</sub> of NW<sup>1</sup>/<sub>4</sub>, Sec. 33; spot elevation "640" on the U.S.G.S. topographic map), and an old "log roll" present on the west coast (SW<sup>1</sup>/<sub>4</sub> of SW<sup>1</sup>/<sub>4</sub>, Sec. 32; "648" on the topo), now overgrown by fireweed, thimbleberry, and figwort, but also with blue-eyed grass and Japanese rose (*Rosa rugosa*).

## Cat Island

Cat Island, shaped like its namesake, has a low isthmus that may be an old tombolo separating the southern "body" from the northern "head" (maximum elevation: 12 m). It is a low, elongate, poorly-drained island with a flora of low diversity (195 species), perhaps because of its remoteness and the poor development of bogs, sandscapes, and weedy habitats. The south tip has a small sand spit and beach, while the west coast consists of low, brushy (in the south) to high, bare (on the northern peninsula) clay bluffs. The eastern shore of the "body" consists of low, possibly slightly calcareous rocky ledges in the south which harbor harebell, three-toothed cinquefoil, *Carex viridula*, and the rare willows *Salix pellita* and *S. planifolia*. To the north of this area is a 1 km long sand beach along the northeast bay. At the northeast tip of the island, spectacular sandstone cliffs appear. These are fringed with white pines and seem to be eroding quickly. No rare plants were found on them.

The pre-settlement forest consisted of large hemlock, white pine, and yellow birch, with smaller amounts of sugar maple, red oak, white cedar, and balsam-fir. Logging began in the 1880's, when pine was cut, and continued through at least the late 1940's, when severe high-grading for hardwoods took place; probably no significant fires followed logging (Swain 1986).

Presently (Brander et al. 1978) the forest is dominated by white cedar (especially on the east coast), yellow birch, white birch, balsam-fir, and sugar maple, the latter exhibiting good regeneration. Occasional very large (up to 1 m dbh) relict specimens of yellow birch and hemlock are encountered. Basswood and hop-hornbeam are uncommon in the interior, while

black ash is fairly common in the poorly-drained center of the island's southern body.

Thickets of mountain maple and Canada yew, numerous deadfalls, and a lack of trails make this a difficult island to hike, especially near the coasts and north peninsula. Yew is dominant; the island had low (1.2 killed/mi²/year) irruption-era deer populations, although the animals persisted until the early 1970's. The most common species in the depauperate groundlayer are wood ferns, shining clubmoss, starflower, Canada mayflower, smooth white violet, and corn-lily. The mesic component consists of only a few colonies of nodding trillium, jack-in-the-pulpit, lady fern, and the sedge *Carex leptonervia* in short ravines on the west coast north of the spit.

While no true bogs occur on Cat Island, there is a boggy woods ("Cat's Head Bog") with black spruce, a few bog ericads, winterberry holly, and three-leaved false Solomon's-seal in the poorly-drained center of the northern peninsula. Swampy alder thickets occur in back of the sand spit and in back of the northeast bay beach, the latter with blue-joint and *Carex vesica-ria* as associates.

A 0.5 ha sand spit forms Cat's "tail" on the southern end of the island. It has been the site of a fishing cabin for many years but has been little modified by human disturbance. The west side dune community is dominated by beach grass, while beach pea, beach wormwood, common hairgrass, and common juniper are also present. The dry bank in back of the dune has a small stand of white and red pines, with an understory of bearberry, blueberry, pipsissewa, and common wintergreen, species absent elsewhere on the island.

Disturbed areas with weedy species include the vicinity of the sand spit cabin and an old cabin site clearing on the northwest bay (NE<sup>1</sup>/<sub>4</sub>, Sec. 35), with species such as figwort and, in its northernmost Wisconsin occurrence, poison-ivy (*Rhus radicans*).

#### Devils Island

Devils Island, the northernmost of the Apostle Islands and point of land in Wisconsin, is small and low. Nevertheless, its boreal vegetation, rich flora (250 species), and especially the intricately carved, dripping sandstone cliffs that nearly surround it make it one of the most interesting islands in the archipelago. A first visit on the summer solstice is a memorable experience. One walks up from the East Landing through a fragrant spruce-fir "heath" along a path lined by natural gardens of blooming Labrador-tea, pink lady's-slipper, and cotton-grass, to encounter the latest blooming lilac in Wisconsin next to the keeper's house.

The pre-settlement forest was dominated by large white pines (Finley 1976), with white and yellow birch and balsam-fir also occurring. Because of its remoteness, difficulty of access, and status since 1891 as a government lighthouse reservation, Devils Island has been spared extensive logging, although selected large white pines may have been removed prior to 1900.



FIGURE 15. True boreal forest of balsam-fir, white spruce, and white birch near west landing on northern Devils Island. Note *Usnea* sp. lichens on branches, 21 June 1991.

The large pines and hemlocks cored by Swain (1986) were all determined to be at least 275 years old.

The best example of boreal forest in the archipelago and perhaps in the state is found on the northern two-thirds of Devils Island (Fig. 15). The dominant trees are balsam-fir, white cedar, white and black spruce, and white birch, with scattered super-canopy white pines and a very few large hemlocks. In interior sites the forest is open and grades into sedge bog, while in coastal locations the stunted, wind-blasted trees form a thick krumholtz community (Fig. 11). Common shrubs include velvet-leaved blueberry, Labrador-tea, creeping snowberry, and twinflower; Canada yew is widespread on coastal bluffs but not important inland on this deerless island. The most common herbs are corn-lily, bunchberry, starflower, bracken fern, Canada mayflower, pink lady's-slipper, and goldthread (*Coptis groenlandica*). Lichens such as *Usnea* sp. are common, and Wetmore (1990) reported several rare species such as *Pseudocyphellaria crocata* (L.)

The one mile walk from the lighthouse at the north end to the boathouse on the south end of the island reveals dramatic changes in the vegetation. From the keeper's house lawn, one proceeds through boreal forest (with boggy ditches on both sides) up a sandy knoll and then down into a 3 ha ericad-sphagnum bog (Fig. 9) with scattered large white pines, tamaracks, and black spruces, the common bog ericads and sedges, and, in the wet, peaty sand of the roadbed, club-spur orchid, bog clubmoss (Lycopodium inundatum), cranberries, and round-leaved sundew. South of the bog, the road climbs to the highest point on the island, which has a flat exposure of Chequamegon Sandstone, and enters an old-growth stand of large yellow birch, white birch, balsam fir, and white cedar, with a few large sugar maples. Canada yew and mountain maple are dense and dominant here, and mesic forest herbs such as lady fern, wood millet, rosy twisted-stalk, nodding trillium, and Carex leptonervia are occasionally encountered. On the steep banks on the southwesternmost side of the island are many huge white pines, and, in the recent past, a few red pines (Doolittle, pers. comm.). Finally, at the southern end of the island there is a campsite, boathouse, and dock, and some low clay bluffs.

The foremost botanical attraction of island is the semi-shaded, dripping, Devils Island formation sandstone cliffs, especially at the north tip (Fig. 11). Although not high (maximum height, 10 m), these cliffs and the adjacent bluff edges have abundant populations of both butterwort and bird's-eye primrose; three-toothed cinquefoil, fragile ferns, bog reedgrass (Calamagrostis inexpansa), and the sedge Scirpus hudsonianus also occur. In crevices on wave-splashed shelves of the west coast grows shore sedge (Carex lenticularis) and flat-leaved willow. Bartram's juneberry and rare or uncommon sedges (Carex aurea, C. capillaris, C. castanea, C. deflexa, and C. concinna) grow on bluff edges and krumholtz margins at the extreme north tip.

The exotic component of the flora is large; the area around the light station has been repeatedly cleared for the past century, and parts of this brushland have the aspect of a European meadow with colorful alien and native species such as sweet william, moss phlox (Phlox subulata), sweet grass (Hierochloë odorata), blue-eyed grass (Sisyrinchium strictum), common buttercup, and orange hawkweed growing side-by-side; the lawn boasts the Eurasian sedge Carex ovalis in its only Great Lakes area occurrence. Near the cliff edge is an unusual mix of native and alien species including pink pyrola (Pyrola asarifolia), barren strawberry (Waldsteinia fragarioides), sunflower (Helianthus sp.), gray goldenrod (Solidago nemoralis), a few bushes of thimbleberry and juniper, and the uncommon least moonwort (Botrychium simplex). The most interesting exotic is heath rush (Juncus squarrosus), which is common on boggy roadside ditches at the northern tip of the island. First collected in 1977 by W.E. Tans, recollected and identified by T.S. Cochrane in 1980, and still thriving in 1992, this is the first and so far only record of this European species from North America outside of Greenland. Seeds could have been introduced on the treads of the bulldozer (now abandoned near the West Landing) that was

brought to the island in the 1950's by the Coast Guard (R. B. Brander, pers. comm.) to complete the north-south road, after service at a U.S. military base in Greenland. If it arrived in this manner, heath rush would indeed be an odd relict of the Cold War, on a cold island.

## Eagle Island

Eagle Island is a small, low, Orienta Formation Sandstone plateau completely surrounded by cliffs. Deep, dangerous crevices nearly split the island in several places. Despite its name, Eagle Island is a sanctuary for breeding herring gulls, cormorants, and great blue herons. Casual visits are not allowed. Based on visits in 1982 (by Koch) and 1991 (Judziewicz) the vascular flora consists of 74 species. The interior is forested with mostly polesized white birch, white cedar, balsam-fir, and a few large yellow birch. Canada yew is dominant in the understory of this deerless island, and mountain maple and beaked hazelnut are also frequent. The depauperate understory flora includes a few individuals of starflower, sweet white and marsh blue violets, wild sarsaparilla, jack-in-the-pulpit, and the sedge Carex brunnescens. There is a tiny, overgrown clearing near the south tip, where cow-parsnip, fireweed, Canada goldenrod, and yarrow are common. The sandstone cliffs and ledges, especially on the west coast, have a heterogeneous flora of weedy native and introduced species, several of which were probably introduced by gulls: fragile ferns (Cystopteris fragilis and C. ×laurentiana), pineapple-weed (Matricaria matricarioides), common knotweed (Polygonum aviculare), low cudweed (Gnaphalium uliginosum), Poa nemoralis, and vellow rocket are present here.

Another small island once existed several hundred meters to the southeast of Eagle Island. As photographed by Turner (1888), "Little Steamboat Island" (Eagle was known as "Steamboat Island" at this time) had an area of about 500 m², rose about 5 m above the lake surface, and was vegetated by shrubs, perhaps alders. It was composed entirely of gravel and clay and was washed away by a storm in about 1898, thus illustrating the ephemeral nature of these islands in geologic time. The remains persist as a shoal under

3.5 m of water (Brander & Bailey 1983).

### Gull Island

Gull Island, a gravel ridge about 1 ha in area and currently rising only 1-2 m above the lake (Tans gave the height in 1977 as about 3 m), is the smallest and lowest of the Apostle Islands. It was formerly used as a fish-cleaning station and currently has a small light tower. Gull Island is a bird sanctuary that is off-limits to the public; it is estimated that 60% of all Lake Superior herring gulls are hatched here. The island lies 1 km northeast of the eastern tip of Michigan Island, and Nuhfer and Dalles (1987) noted that the two are connected by a reef less than 60 cm below the surface and may at one time have been united. Indeed, Whittlesey (1852) noted that Gull was

separated from Michigan Island sometime after 1826. Clearly this speck of land may soon follow the fate of Little Steamboat Island.

The first report on the vegetation was made by the General Land Office Survey of 1852-1857, which noted the presence of several 10-12" dbh sugar maples, surprising in view of the exposed nature of this tiny islet. This mesic forest component was confirmed by botanists Lane (in 1955 and 1956), Middleton (1979), and Koch (1982), who collected Canada yew, yellow birch, Chilean sweet cicely, sweet-scented bedstraw, and the only archipelago occurrence of dutchman's-breeches from a "mesic central ravine." None of these taxa were observed during a visit of 19 August 1991, and they may have been naturally extirpated during the past decade, perhaps by the island's steady erosion.

Presently Gull Island is covered with a scrub of red-berried elder, june-berries, mountain maple, pin cherry, and showy mountain-ash. The most common herbaceous species are fringed false buckwheat, goosefoot (*Chenopodium album*), and pineapple-weed; other weeds include giant-chickweed (*Myosoton aquaticum*) and white sweet clover (*Melilotus alba*). A total of 50 species have at one time or another been collected on Gull Island, and of these nearly half are exotics. The 1991 visit revealed only 30 species. Clearly species turnover rates are high on this island, driven by both high immigration (gull dispersal) and high extinction (washover, stochasticity) rates. A precise calculation of turnover rate is not possible because the pre-1991 surveys did not include exhaustive species lists. However, by combining the species noted or collected during the 1979 and 1982 visits but not relocated in 1991, a minimum turnover rate of 2.7% per year is obtained. The true rate is probably significantly higher.

### Hermit Island

Hermit is a small island with a moderately diverse flora (232 species). Low clay bluffs occur at the western end, sandstone outcrops (mostly low) on the northwestern through southeastern shores, and two narrow sand and gravel beaches on the southern shore and on the northwestern shore near the outlet of a small stream. Shaded, mossy sandstone boulders at the extreme northern tip harbor small colonies of the rare fir clubmoss and spike trisetum.

Pre-settlement vegetation on the well-drained eastern two-thirds of the island was large white and red pine, with some sugar maple, hemlock, and white birch. The poorly-drained western part had stands of white cedar and balsam-fir, while sugar maple and white cedar dominated the southeast shore. Hermit Island has had a long history of human disturbance, beginning with the tenure of the hermit Wilson from 1847–1861. Logging, extensive fires (Swain 1986), quarrying, and agriculture to support the quarry workmen followed, with up to 100 people resident during peak periods of activity near the end of the 19th century. Presently (Brander et al. 1978, Anderson et al. 1983) the forest is dominated by white birch, white cedar, balsam-fir, sugar maple, yellow birch, red maple, and quaking aspen, with a

few pines present along the rocky bluffs and south beach. A small, remnant hemlock-sugar maple-yellow birch stand with some hop-hornbeam occurs on steep, east-facing slopes inland and about 1 km north of the quarry. The swampy eastern end of the island has thickets of balsam-fir, white cedar, and yellow birch in which black ash is an important component.

The most common shrubs are mountain maple, beaked hazelnut, and fly honeysuckle. Canada yew is uncommon, in part because irruption-era deer populations were high (6.6 killed/mi²/year), and perhaps also because of fires and the xeric nature of some of the island. Thimbleberry is fairly common but declining as the forest matures. The groundlayer is diverse; in order of abundance the most common species are corn-lily, Canada mayflower, starflower, big-leaved aster, wild sarsaparilla, wood ferns, roundbranched ground-pine, rosy twisted-stalk, bristly clubmoss, and bunchberry; Solomon's-seal and false Solomon's-seal are occasional, while maidenhair fern is rare.

The south beach and the slopes leading to it are the most xeric part of the island. Here are found white and red pines mixed with red oak and white birch; in the understory, bracken fern, lowbush blueberry, and wintergreen are frequent. Balsam-poplar, prairie willow (Salix humilis), fireweed, evening-primrose, wild oat-grass (Danthonia spicata), and pearly everlasting are occasional along the south beach.

Hermit Island lacks extensive wetlands, but a ravine in the northwestern part has a marshy alder thicket near its mouth that includes species such as blue-joint, tussock sedge, fowl meadow-grass, tall manna-grass (*Glyceria grandis*), swamp cinquefoil, calla-lily, marsh-marigold, blue flag, and water-hemlocks. A nearby narrow beach has common juniper and common hairgrass.

Weedy habitats include the 1891 Excelsior Brownstone Quarry (with common polypody on the rock faces and ledges) and just north of it the fast-disappearing Bruder Farm clearing. Remnants of cultivation here include apple and pear trees. Also found are common burdock, European highbush cranberry (*Viburnum opulus*), agrimony, Virginia creeper (*Parthenocissus inserta*), and the beautiful ragged fringed orchid.

## Ironwood Island

A low, circular piece of land about one square mile in area, Ironwood Island has an impoverished flora (176 species) because of low habitat diversity; there are no wetlands. Low clay bluffs occur on the western, southern, and part of the eastern shores. Generally low sandstone ledges and cliffs occur on the northern and (more prominently) northeastern shores; scattered colonies of butterwort and spike trisetum occur here on the moist, mossy, north-facing rock faces, sometimes below cliff-top red and white pines.

The pre-settlement forest included very large hemlocks as well as abundant white cedar and yellow birch. The first documented record of logging on the island is from the early 1950's (some may have occurred much

earlier), when a camp was established on the cuspate foreland (Middleton 1983); this camp was bulldozed, with attendant severe disturbance to the dunes, at the end of that decade (Nuhfer & Dalles 1987). Post-logging fires

do not appear to have occurred.

Presently the forest is dominated by pole-sized balsam-fir, white cedar, white and yellow birch, and smaller quantities of sugar maple, red maple, and hemlock; red oak, basswood, and hop-hornbeam are rare. The poorly drained interior has some black ash, and a tiny ravine about 0.5 km northwest of the sandscape has mesic species such as lady fern, nodding trillium, dwarf ginseng, and Chilean sweet cicely.

Despite moderate deer populations (3.6 killed/mi²/year) in the 1950's, Canada yew is the dominant understory shrub, even though University of Wisconsin P.E.L. notes from 26 June 1956 describe the yew cover as very sparse. Yew, abundant mountain maple, and numerous deadfalls make hiking the island unpleasant. Beaked hazelnut and red-berried elder are other widespread shrubs. The groundlayer is impoverished: the most frequent herbs are wood ferns, shining clubmoss, starflower, white violets, corn-lily, and Canada mayflower.

As noted, the cuspate foreland on the south end of the island was moderately to severely disturbed by logging activities. Just north of the dunes is a small clearing with numerous exotics persisting from the logging camp days. On the dunes the most common plants are red raspberry, quack grass, Canada blue grass, king-devil, timothy, and sheep sorrel, but the natives beach grass and beach pea are becoming re-established on the aggrading, southeastern side of the foreland. A large blowout of bare or sparingly vegetated sand, with scattered trees of white birch, gives the single campsite a pleasant parklike aspect.

# Long Island

Long Island is geomorphologically not a part of the Apostle Islands but is rather a long (12 km, of which about 5 km are in the Lakeshore) narrow (50-400 m wide) peninsular sand spit extending northwestward from the mainland. Technically it is a recurved "barrier spit" that has been part of the Chequamegon Point peninsula since the November 1975 storm that sunk the Edmund Fitzgerald. Its insular and peninsular status alternate on a time scale of decades. When detached, it is properly designated a "barrier island" (Nuhfer & Dalles 1987). The National Park Service's portion of the peninsula, acquired in 1986, covers about 200 ha and consists of a series of open to forested dune ridges and swales rising to a maximum elevation of only 4-5 m above the lake. The vascular flora is in relative terms by far the richest in the archipelago (356 species, or about 75% higher than what would be expected from Long's size) due to proximity to the mainland, intensive collecting by botanists starting with Cheney in 1896, and especially the great diversity of dynamic, mostly open, wetland habitats. In spite of these open habitats, the alien component of the flora is a surprisingly low 12%, well below the archipelago average.

Bona (1990) studied and summarized the geomorphic processes that created this young island, which originated only about 1,050 to 1,700 years ago when the outlet of the Bad River moved from Chequamegon Bay eastward to its present discharge into Lake Superior proper. This delivered sediment which northwestward-flowing longshore currents then deposited as a peninsula/island whose development has been, and continues to be, very dynamic. Shorelines change constantly and sometimes dramatically. This is reflected in the numerous narrow beach ridges and swales present on the island proper. These number about a dozen; one forms on the average of each century or so. The oldest ridges are on the bay (south- and southwest-facing) side of the island. On the lake (north- and northeast-facing) side approximately west of La Pointe Light, the island is rapidly accreting to the extent that the ruins of the old Chequamegon Point Light keeper's house, which was near the north shore at the turn of the century, is now in a jack pine forest over 100 meters inland.

The human history of the island doubtlessly began soon after its formation, because it is a natural cross-roads for trade and travel. Burnham (1929) noted the "Battle of Chequamegon Point" that was fought here between the Sioux and Ojibwe tribes, and the island was probably an outpost for the early French trappers and traders. After white settlement, the Chequamegon Point Light was built on the western tip in 1858, and another (La Pointe Light) 1.5 km east of the tip in 1896. A commercial fishery operated from the west tip of the island from 1869 until the 1920's, and, later, several vacation cabins were built near the eastern tip.

The pre-settlement vegetation was recorded as a forest of red pine, white pine, white birch, and quaking aspen on the ridges, alternating with alder thickets and sphagnum-sedge bogs in the swales towards the bay side; certainly jack pine and oaks must have also been present. Doubtlessly cutting and fires have occurred since the 1850's, but the latter do not appear to have been extensive. The present forest has changed to the extent that white pine, birch, and aspen are not now dominant.

McEachern (1991) studied Long Island's physiographic ecology and produced a comprehensive vegetation map. Presently the ridges of the island proper have three types of forest, all fairly low in stature: 1) red pine, commonest on many of the bay side ridges; 2) Hill's oak (*Quercus ellipsoidalis*; or a Hill's×red hybrid), commonest near the lake side on the eastern side of the island; and 3) jack pine, dominant from the west tip east throughout Sec. 18, in the stabilized dune zone just south of the lake side active dunes and dune grassland. All forest types are fairly young. Swain (1986) dated the oldest red pine stands as having originated in the early 1890's (some individuals may date back to about 1840), and the jack pines to about 1870. Tree diversity is not great; about the only significant associates are pole-sized red maple and quaking aspen.

Common understory species in the red pine and oak forests include common juniper, huckleberry, lowbush blueberry, and bracken fern. The shaded, acid swales in these stands are dominated by blue-joint, leatherleaf, and fowl manna-grass. The jack pine stands vary from closed forest to open

savanna, and have an understory of common juniper, false-heather, bearberry, common hairgrass, sand cress, three-toothed cinquefoil, and reindeer lichen (Cladina rangiferina (L.) Nyl.). An unusual habitat is a series of shrubby swales dominated by jack pine and willows, in the dune accretion zone near the island's northwest tip. Walking through any of these forests is often unpleasant because of numerous deadfalls and the stiff, spreading branches of many of the shrub and tree species. Also, unlike in any other part of the Lakeshore, poison-ivy (Rhus radicans) is common, especially on semi-stabilized sand on the inland side of the first beach ridge. Further southeast of the island proper, this species is abundant on the dunes and demands respect. Canada yew is not present on the island, probably due to its generally xeric upland environments. Mainland animals such as deer, ruffed grouse, bear, chipmunk, and skunks are frequent, often as transients, and may have some impact on the vegetation and microfauna: dog ticks, uncommon on the other islands, were extremely abundant here in May 1992.

The linear sphagnum-sedge bogs on the bay side of the island proper have a fairly complete bog flora including many sedges, ericads, sweet gale, insectivores, and sweet flag (*Acorus calamus*). Scattered throughout these bogs are large white pines and small groves of tamaracks. Near the eastern end of the island, black chokeberry (*Aronia melanocarpa*) and bog birch (*Betula glandulifera*) are present in their only Lakeshore occurrences.

All of the common native dune plants are present on the beaches of Long Island, plus some uncommon ones such as bugseed and Russian-thistle (Salsola iberica). Willows are common, with 10–11 species present including blueleaf willow and perhaps hoary willow (Salix candida); the alien hybrid S. ×rubens is fairly common as a weed tree on the bay shore, along with Norway maple (Acer platanoides). Heart-leaved willow is dominant on the dunes west of La Pointe Light (Fig. 16).

The ephemeral sand ponds nestled among the dunes near the island's western tip are diverse habitats. The bottoms of the ponds themselves were dominated in 1992 by extensive growths of water-milfoil (Myriophyllum heterophyllum). Along the pond margins grew foxtail (Alopecurus aequalis), water star-grass (Heteranthera dubia), rushes (Juncus spp.), and many sedges, including Carex diandra, C. hystericina, C. vulpinoidea, and the threatened shore sedge C. lenticularis. Just south of the extreme western tip is a bog pool with a diverse species mix that includes white water-lily, greater duckweed (Spirodela polyrhiza), and arrowheads (Sagittaria latifolia and S. rigida). Aquatic plants are frequently washed up on the bay side of the island and include pondweeds (Potamogeton spp.), naiad (Najas flexilis), wild-celery (Vallisneria americana), waterweeds (Elodea canadensis and E. nuttallii), coontail (Ceratophyllum demersum), and watermarigold (Megalodonta beckii). Some of these species apparently grow in the shallow water of Chequamegon Bay.

Proceeding southeast from the old southeast tip of Long Island proper, the isthmus becomes a series of low dunes and swales vegetated by a brushy mixture of speckled alder, green ash, white birch, and quaking aspen copses



FIGURE 16. First dune crest on northern side of Long Island, just west of La Pointe Light Coast Guard Station. Heart-leaved willow (*Salix eriocephala*) dominates the crest, with beach grass on both sides and jack pine and common juniper on stabilized dunes farther inland (left); note poison-ivy (*Rhus radicans*) in lower left, 30 May 1992.

with willows and sweet gale in the shrublayer. After about a mile, the dunes flatten out into a broad plain that is the most species-rich habitat on the island. This is the "Sand Cut," a wet *Carex-Juncus* meadow on the bay side of the filled-in breach; it is the area where the 1975 storm re-attached the island proper to Chequamegon Point.

Sweepstakes dispersal has resulted in a rich mixture of both native and exotic species here, many uncommon or absent elsewhere in the archipelago. These include Loesel's twayblade (Liparis loeselii; collected by Cheney in 1896 and still present in 1992), hooded ladies'-tresses (Spiranthes romanzoffiana), closed gentian (Gentiana andrewsii), cottonwood (Populus deltoides), turtlehead (Chelone glabra), false dragonhead (Physostegia virginiana), rice cut-grass (Leersia oryzoides), muhly-grass (Muhlenbergia mexicana), barnyard-grass (Echinochloa muricata), American elm (Ulmus americana), staghorn sumac (Rhus typhina), box elder, silver maple (Acer saccharinum), Virginia creeper, swamp milkweed (Asclepias incarnata), bittersweet nightshade (Solanum dulcamara), cocklebur (Xanthium strumarium), tall sunflower (Helianthus giganteus), common tansy (Tanacetum vulgare), monkey-flower (Mimulus ringens), blue vervain (Verbena hastata), Indian-tobacco (Lobelia inflata), butter-and-eggs (Linaria vulgaris), marsh bellflower (Campanula aparinoides), leathery grape-fern, and Cype-

rus schweinitzii. The threatened shore sedge also occurs here. Of special concern is the recent (ca. 1988) invasion of purple loosestrife (*Lythrum salicaria*), a noxious wetland weed. It was common by 1992 and the object of an intensive eradication program. J. F. Van Stappen (pers. comm.) suggests that the Long Island-Chequamegon Point barrier spit may serve as an obstacle to the northward transport by water of weedy species common in Chequamegon Bay, including the city of Ashland and the Fish Creek Sloughs, where, for example, purple loosestrife is common.

#### Madeline Island

Madeline Island is the largest of the Apostles, and while not part of the National Lakeshore it is geomorphologically a natural part of the group. A low, elongate island with a diverse flora (534 species, including 51 not occurring within the Lakeshore proper), it is the only member of the archipelago with a permanent human population (ca. 190 in 1990) and large areas of land cleared for agriculture (although there are no active farms in 1992). The coastline consists mostly of low to high clay bluffs. Sandstone is prominent in only two places: at the northern tip (Steamboat Point; SW<sup>1</sup>/<sub>4</sub>, Sec. 22 of T51N, R2W) spectacular sheer cliffs with spike trisetum occur, while at Big Bay Point (Sec. 19 of T50N, R2W) lower cliffs and ledges are found, also with spike trisetum. Sandy beaches are developed at Big Bay and Amnicon Bay, and there is a small sand spit (Grants Point) at the island's southern tip.

Madeline Island has had a long human history (Holzhueter 1974). Major settlements were made by Ojibwe Indians starting in about 1490. The first white visitors were French explorers who arrived in the early 1620's, and by 1693 a small fort had been built near Grants Point. For the next century and a half, the island was the economic and administrative center for white enterprises in the western Lake Superior region, most notably the fur trade. By the 1830's, commercial fishing was thriving at the present village of La Pointe, but with the introduction of steamships and railroads the economy of the island declined. Tourism, beginning in the 1890's, has been the backbone of the local economy during the past century.

The island suffered extensive logging even before the General Land Office Survey of the 1850's. Finley (1976) shows hemlock/northern hardwoods to have been dominant, with some boreal forest present in the southern part and pine forests near the southern tip. Logging has continued until the present day but, balancing this, many areas previously cleared for agriculture are now reverting to forests. Today the upland forests are dominated by mostly pole-sized white birch, quaking and large-toothed aspen, red and sugar maple, and balsam-fir, with scattered coastal white pines. Near the island's high northern tip (Sec. 28–29 of T51N, R2W), nice secondgrowth stands of hemlock, sugar maple, and yellow birch occur on steep slopes and in short, deep ravines, where groundlayer associates include black snakeroot, wood millet, wild oats, rosy twisted-stalk, and the uncom-

mon sedge Carex scabrata. Other forest plants of southern affinity found

on Madeline Island but rare or absent further north in the archipelago are skunk-cabbage (*Symplocarpus foetidus*), long-bracted orchid (*Coeloglossum viride*), American elm, spurred-gentian (*Halenia deflexa*), and hairy honeysuckle. Munsing Town Park, located about 1 km northeast of La Pointe (NW<sup>1</sup>/<sub>4</sub>, Sec. 29 of T50N, R3W), has a remnant conifer forest of large white and red pines, white spruce, and balsam-fir.

The entire island has suffered from extremely high deer densities (6.2 killed/mi²/year for the period 1946–1975; about 60/mi² at present), which inhibit woody seedling establishment and have eliminated the ground layer in some locations. Understory shrubs include beaked hazelnut and moun-

tain maple; Canada yew is virtually absent.

Two bog complexes, both old lagoons that have been enclosed by bay mouth bars, are the most notable botanical attractions of the island. Big Bay bog is part of a large (951 ha) Wisconsin State Park and consists of a 2.3 km long sandy, pine-forested barrier beach, together with a 200 ha boglagoon complex inland to the east (Tans & Read 1971). The barrier beach rear dune area has all three native pines and the shrub layer is dominated by huckleberry, bearberry, and false-heather. Foredune herbs include common hairgrass, Festuca saximontana, jointweed, bugseed, sand cress, and threetoothed cinquefoil as well as the ubiquitous beach grass. The richness of the bog flora rivals Stockton Island's Julian Bay bog, and indeed any in the state. Present in the sphagnum-sedge mat, in addition to the common bog species, are Scheuchzeria palustris, Carex buxbaumii, C. chordorrhiza, C. tenuiflora, coast sedge (C. exilis; dominant), Michaux's sedge, sooty beakrush, sweet flag, pipewort, yellow-eyed grass, dragonmouth, grass-pink, and rose pogonia. The threatened linear-leaved sundew has also been collected here. The shrub zone surrounding the bog is diverse and includes tall thickets of royal fern (Osmunda regalis). The lagoon has several species of pondweeds and bur-reeds, wild-celery, naiad, waterweed, water-milfoil (Myriophyllum verticillatum), and water-marigold, as well as floating aquatics. Well west of the open bog are additional beach ridges dominated by pole-sized red maple and white birch, these separated by swales with white cedar, speckled alder, Labrador-tea, and royal fern. Roadsides and clearings at Big Bay State Park campground harbor several colonies of the rare pale sedge (Carex pallescens).

The Amnicon Bay bog lagoon and beach complex occurs on the north-eastern shore near the eastern tip of the island (NW<sup>1</sup>/4, Sec. 35 of T51N, R2W). It consists of a 5 ha bog lagoon, an adjoining 25 ha bog wetland, and a 1 km long barrier beach; land ownership is divided between the Red Cliff Indian Reservation and private landowners, who have recently built vacation homes on the barrier beach. The bog flora is rich and includes yelloweyed grass, dragonmouth and other orchids, as well as the common bog

sedges, ericads, and insectivores.

Grants Point is a disturbed sand spit at the island's southern tip that bears strong floristic similarities to Long Island, which is only a few kilometers to the south. The dune forest harbors a mix of trees including jack pine and quaking aspen, and wood rush (*Luzula acuminata*) and poison-ivy are

present in the understory. Russian-thistle is found on the beach, common juniper and false-heather on the dune grassland, and numerous species of rushes and sedges such as *Carex diandra* and *C. hystericina* near an ephemeral dune pond.

On the opposite end of the island (SE<sup>1</sup>/<sub>4</sub>, Sec. 21 of T51N, R2W), just west of Steamboat Point and the northern tip, is a rather prominent halfmile long cuspate foreland with many dune species such as beach grass, beach pea, beach wormwood, and ground-cedar (*Lycopodium trista-chyum*). The beach ridge just inland has large second growth white pine and red oak, and still farther inland is a long swale dominated by blue-joint, sweet gale, and speckled alder.

Because of its road network, permanent human population, and numerous summer homes inhabited by enthusiastic gardeners, Madeline Island's flora has a large exotic component (23%). Many of these species are casual roadside weeds while others have escaped and are becoming widely naturalized, such as the garden lupine (*Lupinus polyphyllus*). A few pernicious weeds occur. Purple loosestrife is troublesome in the marina marsh (Henry 1986), and Japanese barberry (*Berberis thunbergii*) and common buckthorn (*Rhamnus cathartica*) have become established on roadsides and in disturbed woods near La Pointe, where they are apparently two of the few shrubs that can withstand the heavy browse pressure from white-tailed deer.

#### Mainland Unit

The Mainland Unit of the Apostle Islands National Lakeshore extends along the Lake Superior shore from the outlet of Saxine Creek (into Squaw Bay) 18 km east to Little Sand Bay, and from about 0.5-1.5 km inland. In the far west (Sec. 19 of T51N, R5W) the shoreline consists of low clay bluffs dissected by small ravines. From Sec. 18 to Sec. 9 are the spectacular northwest-facing Squaw Bay sandstone cliffs (Devils Island Formation), with abundant populations of bird's-eye primrose; populations of the uncommon sedges Carex capillaris and Scirpus hudsonianus are also present. Clay bluffs with small ravines again predominate from Sec. 9 northeast nearly to Sand Point (Sec. 34-35 of T52N, R5W). Just west of Sand Point are low cliffs with populations of bird's-eye primrose. From Sand Point, a narrow sand beach, better-developed farther east, extends to the 80 ha Sand River estuary complex in Sec. 1 of T51N, R5W. Low clay and rock bluffs begin again in Sec. 6 and extend to Little Sand Bay in Sec. 32, 29, and 28 of T52N, R4W, where there is a small wetland complex and barrier beach.

The original land survey of the 1850's recorded the pre-settlement vegetation as dominated by hemlock, yellow birch, and white cedar with lesser amounts of balsam-fir, white pine, and some white birch groves, especially near Little Sand Bay. Logging, initially for white pine, began in the 1890's (Frederick & Rakestraw 1976) and continued intensively through the 1970's. Presently the forest is dominated by pole-sized quaking aspen, white birch.

sugar maple, balsam-fir, and some white spruce (Dickas et al. 1974). White and red pines are present on the barrier dunes on either side of the outlet of the Sand River. Very little old growth is left except for a few hemlocks and hardwoods in the small but rugged ravines just south of Little Sand Bay. These ravines also harbor populations of the uncommon sedge *Carex scabrata*, round-leaved orchid, long-bracted orchid, and the threatened broadlipped twayblade.

There is a stand of large white cedars just southeast of Sand Point that serves as a winter deer yard. It was probably from here that Cheney collected calypso orchid (*Calypso bulbosa*) in 1897; the species was not found in 1992 and may be extirpated from the Lakeshore. The forest understory is dominated by heavily browsed beaked hazelnut and mountain maple, with yew rare, as it is throughout the Mainland Unit.

Two barrier beach/bog complexes are found in the Mainland Unit. The smaller is found just northeast of the Little Sand Bay dock (SW¹/4 of SW¹/4, Sec. 29 and NE¹/4 of NE¹/4, Sec. 32 of T52N, R4W); the beach is dominated by beach grass and beach pea, while the small (2-3 ha) marshy bog in back of it has sweet gale, sweet flag, cranberries, leatherleaf, pitcherplant, common cat-tail, blue flag, yellow loosestrife, swamp cinquefoil, bur-reed, yellow pond-lily, dragonmouth, buckbean, and numerous sedges including *Carex diandra* and *C. lacustris*. Slough-grass (*Beckmannia syzigachne*) has been collected from wet sand here.

The Sand River bog or estuary complex (N1/2, Sec. 1 of T51N, R5W and SW<sup>1</sup>/<sub>4</sub>, Sec. 30 of T52N, R5W) is much more extensive (over 100 ha). The extensive beach has many dune species, and the ridge on the west side of the river has a scenic, nearly pure stand of red pines. In back of the barrier beach are alder-willow-dogwood thickets that grade into a marshy bog mat with pools of open water. These wetlands rival Long Island in the diversity of submersed and emergent aquatic plants. Present here are river horsetail (Equisetum fluviatile), water-plantain (Alisma plantago-aquatica), waterweed, pondweeds, bur-reed, water starwort, coontail, sweet flag, mare's-tail (Hippuris vulgaris), and water-milfoils. All of the species listed for Little Sand Bay bog are present, plus blue-joint, Carex lasiocarpa, bog willow, turtlehead, false dragonhead, water-parsnip, marsh bellflower, and sneezeweed (Helenium autumnale). Farther west, in NE1/4, Sec. 1, is a true sphagnum-sedge bog with scattered trees of black spruce and tamarack; associates present include Carex chordorrhiza, sooty beak-rush, bog willow-herb, dragonmouth, rose pogonia, horned bladderwort, and bluntleaved orchid (Platanthera obtusata).

A rare native species, fir clubmoss has been collected in a wet, boggy ditch with cranberries and bog clubmoss along the access road to Little Sand Bay (NE<sup>1</sup>/<sub>4</sub> of NE<sup>1</sup>/<sub>4</sub>, Sec. 32 of T52N, R4W). It was not relocated in the present study; however, sweet grass is abundant there. A few woodland species have been found in the Mainland Unit but are rare or absent from the islands; these are spurred-gentian, golden alexanders (*Zizia aurea*), and hairy sweet cicely (*Osmorhiza claytonii*).

#### Manitou Island

Manitou Island is a rectangular piece of land with a flora that is not very diverse (228 species), probably because of the absence of well-developed sandscapes and wetlands. The northern, eastern, and southeastern coasts have low sandstone cliffs; at the northeastern tip, spike trisetum, harebell, and fragile fern (*Cystopteris tenuis*) occur on semi-shaded ledges. The remainder of the island's shores consist of low clay bluffs and narrow sand and gravel beaches. The latter are especially well-developed midway up the northwest-facing coast and near the southern and western tips.

The pre-settlement forest of Manitou Island was dominated by hemlock, with lesser amounts of white cedar, red and white pine, white birch, and red and sugar maple. Logging began before 1895, peaked in the first decade of this century, and occurred sporadically until the early 1970's. Some fires followed logging on this island, but they were not extensive (Swain 1986).

The current forest (Brander et al. 1978, Anderson et al. 1983) is dominated by white cedar (especially in the north), yellow birch, white birch, sugar maple, balsam-fir, hemlock, and red maple. Mature second-growth stands of hemlock-hardwoods occur in the southwestern half of the island, often with an open, parklike understory that is easy to walk through; the observation of forester E. Steigerwaldt (in Frederick & Rakestraw 1976) that the "groundcover resembles a pastured woodlot" is still apt. There is also a fine hemlock stand, which Swain dated as originating between 170 and 190 years ago, about midway along the trail from the fishing camp to the northeast beach clearing.

Canada yew is an insignificant understory species, reflecting former high deer populations (7.2 killed/mi²/year). The dominant shrubs are mountain maple and beaked hazelnut. The herb layer is not very diverse but was well-represented by clubmosses: the commonest species in 1991 were wood ferns, shining clubmoss, starflower, Canada mayflower, rosy twisted-stalk, cornlily, round-branched ground-pine, *Carex arctata*, and bristly clubmoss. Wild oats, false Solomon's-seal, and dwarf ginseng are occasional.

Although there are no large wetlands on Manitou Island, a tiny, linear, upland "boglet" about 100 m long and 20 m wide does occur near the summit of the island, midway along the boundary between Sections 18 and 19. The treelayer has scattered white cedar, hemlock, and yellow birch, and the groundlayer has cinnamon fern, blue flag, pink lady's-slipper, wintergreen, velvet-leaved blueberry, goldthread, and the sedges *Carex disperma*, *C. paupercula*, *C. trisperma*, and *C. tuckermanii*. There is also a wet, sandy swale supporting an alder thicket in back of the beach on the northwest-facing shore just northeast of the western tip of the island. Among the many species present here are sweet grass, tussock sedge, water-parsnip, blue-joint, Canada anemone (*Anemone canadensis*), mad-dog skullcap, red-osier dogwood, marsh fern, and early meadow-rue.

The driest parts of the island are the steep slopes at the south tip, which have red oaks and red pines in the forest, and bearberry, blueberries, and green adder's-mouth (*Malaxis unifolia*) in the understory.

Weedy sites include the northeast beach clearing (SE<sup>1</sup>/<sub>4</sub>, Sec. 7) with blue-eyed grass, figwort, woundwort (*Stachys palustris*), and many others; and the restored fish camp at the western tip (NE<sup>1</sup>/<sub>4</sub>, Sec. 24; cover photograph), with numerous exotics including the showy hedge-bindweed (*Convolvulus sepium*).

Represented now only by a small pile of rocks with a flashing beacon, Little Manitou Island, located about 1 km northwest of the western tip of Manitou Island, was once much larger (150 m long, 50 m wide, and 18 m high in 1895) and vegetated. The till cover was washed away in the 1940's by the U.S. Coast Guard as a navigation hazard (Brander & Bailey 1983), and now supports no vascular plant life.

## Michigan Island

Michigan Island, in spite of its size and remoteness, has one of the richest vascular floras (325 species) in the archipelago, primarily due to the diverse habitats associated with the large sandscape-wetland complex at the western tip. Most of the island is surrounded by high, steep, eroding clay bluffs, but, contrary to Nuhfer and Dalles (1987), bedrock is exposed in the form of a sandstone ledge just south of the east tip.

Pre-settlement forests were dominated by large hemlock, white pine, and yellow birch; white cedar and balsam-fir were common as smaller trees,

probably in the wetter areas. Sugar maple was uncommon.

A lighthouse was constructed in 1857, and early in the 20th century the keepers' wives maintained an elaborate garden and orchard complex, remnants of which still persist. Incredibly, given its poorly-drained soils, small size, remoteness, and the difficulty of landing a boat, there were a few short-lived farmsteads established about 1888; traces can still be seen far east up the northwest-facing shore. Logging started in 1880 (Rakestraw et al. 1976) and peaked in about 1920, when a standard-gauge railroad was constructed from one end of the island to the other. The last episode was a heavy selection cut in the early 1960's (Frederick & Rakestraw 1976). Fires did occur following logging.

Presently the dominant interior forest trees are balsam-fir, white birch, yellow birch, and white cedar (Brander et al. 1978). Red and sugar maple are occasional in the western half, and a small stand of old-growth hemlocks (oldest trees at least 250 years old; Swain 1986), heavily damaged by a recent windstorm, occurs near the east tip. Red oak, basswood, and hophornbeam are uncommon. Numerous windthrows, wetness, dense bluffedge yew and mountain maple thickets, and the lack of trails make forest

walking difficult.

Yew is common and locally dominant, reflecting past low deer populations (1.4 killed/mi²/year). Mountain maple is common and fly honeysuckle is locally frequent along the northwestern coast. The herb layer is diverse and the commonest species in order of abundance are wood ferns, corn-lily, Canada mayflower, starflower, wild sarsaparilla, shining clubmoss, *Carex brunnescens*, and sweet-scented bedstraw. The most mesic site

on the island is a small ravine in SW<sup>1</sup>/<sub>4</sub> of SW<sup>1</sup>/<sub>4</sub>, Sec. 21, near the old railroad terminus; species found here include the sedges *Carex scabrata* and *C. leptonervia*, nodding trillium, false Solomon's-seal, white mandarin, and spikenard. It is worth noting that the Pacific Northwest disjunct rattlesnake-plantain (*Goodyera oblongifolia*) is commoner by far than on any other island, at least during the present survey.

The sandscape-wetland complex on the island's west end is rivalled in plant and habitat diversity only by those on much larger Madeline, Outer, and Stockton Islands. The dunes are best developed on the southern shore and at the extreme western tip, where they are 20-50 m wide and support an impressive "driftwood garden." Beach grass, beach wormwood, beach pea, common juniper, and sand cherry are dominant; sand cress and hairy goldenrod are frequent; and even uncommon taxa like bugseed, poison-ivy, and (reportedly) jointweed occur, although rarely. Inland from the dunes is a dense young (originated ca. 1890-1900; Swain 1986) red pine forest with ericaceous species such as bearberry, pipsissewa, and one-sided pyrola in the understory. On the northwest-facing shore, a small barrier beach, apparently subject to frequent washover, is dominated by speckled alder and protects a 5 ha wetland centered on a 1 ha bog lagoon (Fig. 8). The washover area has peach-leaved (Salix amygdaloides), sandbar, and heartleaved willows. Immediately fringing the lagoon are emergents like cat-tails (Typha angustifolia and T. latifolia), sweet gale, and hard-stemmed bulrush (Scirpus acutus). The bog mat has a rich flora, all the typical species plus the sedges Carex echinata, C. pauciflora, C. paupercula, and C. rostrata; twig-rush, three-way sedge, cotton-grasses (Eriophorum tenellum and E. virginicum), white and (rarely) sooty beak-rushes, yellow-eyed grass, grasspink, bog and balsam willows, grass-pink, marsh St.-John's-wort, buckbean, and horned bladderwort. The open water of the pond (Fig. 8) has abundant water-shield, yellow pond-lily, common bladderwort (Utricularia vulgaris), and pondweeds (Potamogeton berchtoldii and P. illinoensis). Between the bog and the south shore red pine woods is an acid, swampy blue-joint meadow with meadowsweet, leatherleaf, and Carex canescens frequent. Similar open, boggy meadows occur on both sides of the trail that crosses the island east of the bog.

The eastern tip of the island is poorly-drained and has a complex of abandoned beaver ponds that are now reverting to wet meadows dominated by blue-joint, yellow loosestrife, calla-lily, and three-way sedge (Fig. 17). Other species present include rose pogonia, *Carex paupercula*, wool-grass, blue flag, common cat-tail, and mountain-holly. In many places, the meadows are being invaded by speckled alders. Adjacent wooded swamps have black spruce, common wood-sorrel (*Oxalis montana*), creeping snowberry, ostrich fern, *Carex trisperma*, Labrador-tea, three-leaved false Solomon's-seal, club-spur orchid, pink lady's-slipper, skunk currant, and northern bugleweed.

Disturbed habitats include the lighthouse grounds, with numerous species persistent from cultivation such as common periwinkle (*Vinca minor*), and the old railhead midway between the lighthouse and the sandscape tip.



FIGURE 17. Beaver meadow near eastern tip of Michigan Island. Before damming, the site was a conifer swamp. Dominant species are three-way sedge (*Dulichium arundinaceum*), yellow loosestrife (*Lysimachia terrestris*), blue flag (*Iris versicolor*), and calla-lily (*Calla palustris*). Invading woody species include white birch and speckled alder, 29 July 1992.

Clay bluffs near the light have several uncommon native species including dragonhead (*Dracocephalum parviflorum*), pale corydalis (*Corydalis sempervirens*), and purple vetch (*Vicia americana*). The steep, forested bank in front of the lighthouse has many tussocks of ebony sedge (*Carex eburnea*, here in its only Apostle Islands occurrence) in the shade of the big red and white pines.

#### North Twin Island

Tiny North Twin is the third smallest of the Apostle Islands, and one of the most remote. It is surrounded on most sides by low sandstone cliffs and ledges. The vascular flora totals only 124 species and reflects the extreme dominance of Canada yew as an understory shrub; deer have never been present. For research purposes, this pristine island is closed to casual visits. The alien component of the flora is only 6%, the lowest among the islands; a few weeds are present near the Stephan H. Congdon Research Lab cabin near the northern tip.

The pre-settlement vegetation was recorded to include white cedar, yel-

low birch, white birch, and balsam-fir, and doubtless also the scattered super-canopy white pines still seen today in the northern one-third; Swain cored these and found them to be at least 150 and possibly up to 285 years old. The island has never been logged and much of the forest has an open parklike aspect, with, of course, a dense yew understory. The 1991 survey determined the most common trees to be yellow birch, balsam-fir, white birch, showy mountain-ash, sugar maple (several large trees near the south tip), pin cherry, and white cedar. The herblayer is sparse, with wood ferns (Dryopteris intermedia and D. ×triploidea), corn-lily, Canada mayflower, Carex brunnescens, shining clubmoss, and starflower present in low frequencies. The west coast bluff tops have a nearly impenetrable growth of balsam-fir which extends 10-30 m inland, probably the result of spot lightning fires. Red oak (a large single tree near the north tip) and white spruce (a tree near the south tip) are present, but not hemlock. Tangled krumholtz forest with a dense mountain maple understory is present only as a tiny patch at the north tip, with naked mitrewort, twinflower, and Bartram's juneberry in the understory. The southern tip of the island has had several fires in the past few decades, and in places on the eastern side is dominated by pole-sized white birch and balsam-fir with a relatively open understory, little yew, and herbaceous associates such as lady fern, wood-reedgrass, enchanter's-nightshade, and Carex arctata. On the other hand, the western side of the south tip is a yew jungle with the most luxuriant growth seen anywhere in the archipelago. Here, even when walking on top of the decumbent trunks, some individuals tower fully a meter above one's head. Slightly farther north on the west side, near the island's highest point, are swampy woods with Carex disperma, C. trisperma, dwarf raspberry (Rubus pubescens), northern bugleweed, mad-dog skullcap, and bedstraw (Galium tinc-

The eastern coast has extensive sandstone shelves that receive much wave splash. Here the rare plains ragwort is frequent, along with typical shoreline species such as fireweed, wild strawberry, and four common willow species. Rock pool margins feature sweet gale, blue-joint, *Carex echinata*, spikerush (*Eleocharis smallii*), and swamp buttercup (*Ranunculus hispidus*), while in crevices grow occasional plants of three-toothed cinquefoil, sand cherry, and fragile fern (*Cystopteris tenuis*).

The clay banks at the southern end of North Twin Island have golden sedge, panicled aster, bristly sarsaparilla, common hairgrass, wedge-grass, and, at the extreme tip, even a colony of beach pea.

### Oak Island

Oak is a rugged, pentagonal island with nearly twice the relief of any other in the archipelago. Deep ravines radiate on all sides from the summit plateau, especially in the north and southwest coast drainages. The steep topography means that wetlands are absent, and the flora is correspondingly poor (308 species) for an island of this size. The coastline is mostly clay bluffs which reach spectacular heights (65 m) on the northernmost

point; the highest cliffs on the Lake Superior shoreline of Wisconsin. Sandstone cliffs and ledges occur sporadically along the eastern coast and are most noticeable at the "Hole-in-the-Wall" arch in the far northeast. A small cuspate foreland occurs on the southern tip, and sand beaches are slightly developed along the northwestern, northern, and (as a number of tiny "pocket beaches") southern coasts.

The post-glacial history of Oak Island is interesting. The summit plateau (146 m above lake level) was probably the only part of the archipelago to remain emersed during the highest lake level (145 m above the present level) following deglaciation, and indeed Nuhfer and Dalles (1987) noted that "fine, clear sand" is present just below the leaf litter, indicating the former existence of a beach. They also noted the presence of beach ridges and cobble terraces in places near the 1,000, 900, and 800 foot contours.

In pre-settlement times, the forests were dominated by hemlock, white pine, and yellow birch, with white and red pine especially common on the shallower soils of the southern and eastern shores. The township descriptions gave the dominant trees as hemlock, white birch, sugar maple, and red oak (Frederick & Rakestraw 1976).

Oak Island has a long human history. Ojibwe Indians gathered maple sugar on the summit plateau in the mid-1850's (and probably earlier), and had a camp for that purpose. The land survey of this period noted the presence of manmade clearings, and some cutting of wood for steamship fuel had already begun; it is recorded that a General Benjamin G. Armstrong resided on the island from 1855–1862. Commercial logging began in 1871 with high-grading for white pine and hemlock (Hildebrandt 1978a, 1978b; Frederick & Rakestraw 1976) and continued until about 1900. This was followed by logging for hardwoods in addition to hemlock; operations peaked in the 1920's and 1930's. About this time a fisherman and sometime bootlegger named Martin Kane moved into one of the abandoned lumber camp buildings near the sandscape, where he resided until his death in 1947 as the genial "King of Oak Island." On 14 October 1943, sparks from his chimney started a fire that reportedly burned about 4,000 acres, or fourfifths of the island. Smaller-scale logging operations continued in the 1950's (Beals & Cottam 1960).

Presently the forests have a diverse mix of white birch, sugar maple, red oak, red maple, large-toothed aspen, yellow birch, hemlock, hophornbeam, balsam-fir, and basswood. Sugar maple is commonest on the summit plateau, and a remnant virgin stand occurs on the north point overlook (Fig. 18). White birch is abundant on slopes of all aspects, while red oak prefers southwest-facing slopes. Small, aging groves of aspen are frequent along the southern and eastern shores. In general, conifers are not important, except for hemlock in several ravines and white cedar and balsam-fir in poorly-drained woods near the southeastern tip. The paucity of cedar, fir, yew, mountain maple, and windfalls, and the aid of 18 km of maintained trails make this an easy and pleasant island to hike around, except along the coasts, where rugged ravine mouths occur every few hundred meters.



FIGURE 18. Mature sugar maple woods along trail near north point overlook, Oak Island. Red oak and hop-hornbeam are also frequent, 20 July 1992.

Common understory shrubs are beaked hazelnut, fly honeysuckle, and to a lesser extent mountain maple and thimbleberry. Canada yew is rare, not surprising given the fire history of the island. Irruption-era deer densities were low, however (1.0 killed/mi²/year). A small resident herd was present in 1991–1992, and appeared to be increasing (pers. obs.). The herb layer is diverse and common species include wild sarsaparilla, rosy twisted-stalk, big-leaved aster, wood ferns, corn-lily, bracken fern, Canada mayflower, sweet-scented bedstraw, round-branched ground-pine, starflower, false Solomon's-seal, Solomon's-seal, wild oats. The woodland grasses *Brachyelytrum erectum*, *Cinna latifolia*, and *Oryzopsis asperifolia* are frequent. The interesting round-leaved orchid occurs as scattered plants, especially on south-facing slopes and trailsides. It is locally common and the total island population may number about 20,000 individuals.

Given its well-drained slopes and rich-soiled ravines, it is not surprising that the island harbors many southern elements that are uncommon or absent elsewhere in the archipelago. Noteworthy summit and south slope herb species include wood-rush (*Luzula multiflora*), round-lobed hepatica, yellow wild licorice, and squaw-root, a parasite on the roots of red oak; the shrubs include witch-hazel, arrow-wood viburnum (*Viburnum rafines-quianum*), hairy honeysuckle, American hazelnut (*Corylus americana*, common in the western part) and pagoda and round-leaved dogwoods. A hemlock-dominated seepage slope "near the island's center" is reported to harbor a few trees of American elm (Hildebrandt 1978b).

The deepest seepage ravines occur in the north and southwest coast drainages, with shallower ones in the northwest and south coast drainages. Nearly all contain at least a small population of the rare species broadlipped twayblade and drooping sedge (Fig. 23), and the uncommon Carex scabrata. Most ravines have been badly disturbed by logging and fire, but a few have managed to retain small but impressive stands of hemlock, yellow birch, and white cedar, particularly those draining into the north shore in NW1/4 of SW1/4, Sec. 22, west of the trail leading down to north bay campsite. The middle reaches of the ravine that enters the lake at the campsite are noteworthy for their springy, mucky, mossy, white cedar seeps, a habitat otherwise unknown in the archipelago. Interesting species found here include dwarf scouring-rush (Equisetum scirpoides), bulblet fern (Cystopteris bulbifera), Carex aquatilis, C. leptalea, round-leaved hepatica. naked mitrewort, swamp red currant, black snakeroot, white mandarin, spikenard, common wood-sorrel, yellow violet, American brooklime, golden ragwort, and zigzag goldenrod (Solidago flexicaulis). Many of these species are also found in other north bay ravines. Maidenhair fern and the uncommon blue grass Poa alsodes are rare in some southwest and south drainage ravines.

The steep clay bluffs and east coast rock ledges do not boast a very interesting flora. Wedge-grass is common on bare clay, and the ledges at the eastern tip of the island harbor the calciphiles brook lobelia and *Carex viridula*.

The small south tip sandscape has been heavily disturbed but makes a pleasant campsite that features an artesian well. There is a small quaking aspen copse present. The dominant dune species are beach grass, orange hawkweed, beach pea, quack grass, red raspberry, and smooth rose, along with sand cherry, common juniper, beach wormwood, and heart-leaved and sandbar willows. On the northwestern side there is a small, springy alder-dogwood-willow thicket with the associates spotted water-hemlock, rushes (Juncus effusus and J. balticus), blue flag, a bulrush (Scirpus atrovirens), and in the coldest part of the seeping bank, drooping sedge.

The closest Oak Island comes to possessing wetlands are the stream mouth meadows found in several ravines, such as the one at the dock. The species mix here includes *Carex crinita*, spotted touch-me-not, ostrich fern, woodland horsetail, marsh blue violet, cut-leaved water-horehound (*Lycopus americanus*), woundwort, and field-mint (*Mentha arvensis*).

Cleared areas are found in several locations. The old field in the vicinity of the ranger cabin north of the dock has many exotics, as well as the native clammy ground-cherry (*Physalis heterophylla*). The north bay campsite was once an old logging camp, and a thicket of common burdock, cow-parsnip, thimbleberry, and stinging nettle (*Urtica dioica*) are all that remains. The clearing above the sandscape that was the site of Kane's cabin is fringed with hawthorn (*Crataegus chrysocarpa*), wild bergamot (*Monarda fistulosa*), and catnip (*Nepeta cataria*) – Martin Kane had a cat.

#### Otter Island

On Otter Island (228 species), clay bluffs form the western and southern coasts, while the northern and northwestern shores have sandstone bluffs, often with a narrow cliff-top fringe of red pine, white pine, and white spruce and an understory that includes lowbush blueberry, cow-wheat, wild oat-grass, and occasionally Labrador-tea and creeping snowberry. The rugged, seeping, mossy, north-facing cliffs harbor sizable populations of butterwort and spike trisetum, and smaller colonies of fragile fern (*Cystopteris tenuis*) and the rare hybrid clubmoss *Lycopodium* × buttersii.

The pre-settlement forest was diverse and somewhat reflects the local name of "Hardwood Island." There were large individuals of hemlock, red oak, and white pine, and smaller trees of white cedar, balsam-fir, red maple, white and yellow birch, and basswood. Heavy logging during 1903–1904 and 1957–1958 removed most of the large yellow birch and hemlock (Lidfors 1984). The present forest is dominated by yellow birch, sugar maple, and white birch (especially in the far south and east), with pole-sized trees of balsam-fir and white cedar especially common near the shores. Moderate-sized hemlock, red oak, and red maple are found in the north-central part of the island.

In the understory, Canada yew, while common, is seldom tall enough to impede hiking, perhaps because past deer populations were moderate (3.4 killed/mi²/year). Mountain maple and beaked hazelnut are also common. The most frequent herb layer species are wood ferns, shining clubmoss, rosy twisted-stalk, smooth white violet, Canada mayflower, and corn-lily; dwarf ginseng, wild oats, and the mesophytic sedge *Carex scabrata* are occasional, while yellow trout-lily is rare.

A 5 ha partially open shrub bog with scattered white pine, black spruce, and tamarack occurs near the summit of the island about 1 km north of the sandscape. Known locally as "Blueberry Bog," understory species include both blueberry species, small cranberry (*Vaccinium oxycoccos*), leatherleaf, bog-laurel, Labrador-tea, dwarf mistletoe, cinnamon and royal ferns, and the sedges *Carex oligosperma*, *C. rostrata*, and *C. trisperma*. Swain (1986) studied pollen cores from here dating back to about 500 A.D. and noted three possible episodes of fires. His pollen diagram also indicated the occurrence of succession: in the lowest layers, sedge pollen dominates; later, sphagnum moss becomes important; finally, ericaceous shrubs increase. Another recent (but pre-logging) trend in the profile is the increasing importance of spruce, hemlock, birches, and other hardwoods, and the decreasing importance of pine.

A dock and campsite are maintained on the tiny cuspate foreland in the southeastern corner of the island. Native dune species such as beach grass and beach pea grow here, as well as numerous exotics. In one of its two Wisconsin occurrences, satiny willow (*Salix pellita*) grows on the gravelly south shore of the point.

Wild madder (Galium obtusum), honewort (Cryptotaenia canadensis), arrow-leaved aster (Aster urophyllus), pale touch-me-not, and clearweed

(*Pilea pumila*) are all rare in the archipelago but are found on Otter Island in isolated patches in muddy soil on the main trail as it passes through deciduous woods north of the dock. These native species could possibly have been inadvertently introduced during the logging era, or perhaps during the National Camporee of 1960, when 2,000 Boy Scouts invaded the island.

## Outer Island

Outer Island, large and with a moderately diverse flora (366 species), is the most remote Apostle Island; Austad Point is 34 km (21 miles) from the mainland. It is also the second highest, and has a number of drumlinoid hills instead of the single summit found on most of the other islands. The western and northern coasts have high clay bluffs, the eastern coast sand-stone ledges and low cliffs, and a large sand spit is found on the southern tip.

The pre-settlement forest was dominated by large hemlock, white pine, and yellow birch. White cedar and sugar maple were also important, and balsam-fir, red oak, white birch, basswood, and red maple were present in lesser quantities. Logging started in the late 19th century with pine-cutting but the most intensive episodes occurred in the 1920's in the southern half of the island, and in the late 1940's and early 1950's in the northern half.

The Schroeder Logging Company laid 40 miles of railroad from 1922–1926 and, after logging, extensive severe fires burned nearly the entire south half. At this time, a local movement to create an Apostle Islands National Park was in full swing, and the inspector sent by the government to report on the feasibility of the park chose this unfortunate moment (11 August 1930) to tour the southern half of Outer Island (Rakestraw 1976). He found a "smoldering desolate waste," and, partly as a result of his negative report, forty more years were to pass before federal designation would come to the archipelago. A 1938 aerial photograph shows the southern part of the island to be open brushland with many short railroad spurs.

In contrast, the northern half was still roadless, old growth hemlock/hardwoods forest, with the exception of the lighthouse clearing. No beaver ponds are visible on the entire island in 1938. From 1948 to 1960, the Lullaby Logging Company worked the north half and selectively removed yellow birch and sugar maple for furniture manufacture (Frederick & Rakestraw 1976), as well as hemlock. In 1960's air photos, second-growth forest had returned to the south half and a complex of logging roads was visible in the north half. Also visible are numerous beaver flowages, indicating the explosion of that species following the re-establishment of successional forests dominated by aspen, a favorite food. By the mid-1970's (Brander et al. 1978, Anderson et al. 1979, Fraundorf 1984), the forest was maturing and was dominated by white and yellow birch, sugar maple, white

cedar, and quaking aspen, with smaller quantities of red maple, balsam-fir, showy mountain-ash, large-toothed aspen, red oak, and hemlock.

By the present study (1990-1991), quaking aspen was in severe decline, due to maturation of the forest and harvesting by beaver. Beavers also declined and few active lodges remain in the northern half of the island. The difference in disturbance history between the northern (selectively cut but not burned) and southern (intensively cut, then severely burned) halves of Outer Island is reflected in the abundance of many common species. Among the dominant tree species, yellow birch, sugar maple, and especially hemlock are much more common in the north, while white birch, quaking aspen, balsam-fir, red oak, and red maple are more common in the south. Shrub and herb abundance also differs between halves. Canada yew is common and in places dominant in the north, less so in the south; deer have never been present on the island. Beaked hazelnut, fly honeysuckle, and bush-honeysuckle are all much more common in the burned south, mountain maple in the north. In order of abundance, the most frequent herbs are corn-lily, wood ferns, Canada mayflower, wild sarsaparilla, starflower, rosy twisted-stalk, shining clubmoss, round-branched ground-pine, smooth white violet, false Solomon's-seal, bunchberry, big-leaved aster, Carex arctata, lady fern, bristly clubmoss, and partridge-berry; all of these taxa are more common in the south than in the north with the exception of corn-lily and wood ferns, which are about equally common, and the clubmosses, which are more frequent in the never-burned north.

One area was spared the woodsman's ax and chainsaw. In the northwestern corner of the island, 1-2 km west of the lighthouse, is a 75 ha stand of hemlock/hardwoods that was never logged because it was part of the lighthouse reservation. This is the finest tract of virgin timber in the archipelago and indeed one of the best in the Great Lakes region. Individuals of hemlock, yellow birch, and sugar maple approach 1 m dbh, and there are scattered super-canopy white pines. Yew and mountain maple form a dense understory, as well as herbs such as common wood-sorrel and yellow troutlily.

The well-drained, rich-soiled "shelves" all along the bluff tops on the western coast of island are particularly rich in mesophytic species. Here basswood, hop-hornbeam, lady fern, Chilean sweet cicely, white mandarin, dwarf ginseng, wood millet, *Carex leptonervia*, *Brachyelytrum erectum*, Carolina spring-beauty, spikenard, nodding trillium, yellow trout-lily, jack-in-the-pulpit, and pagoda dogwood can all be found.

Sand Point, at the island's south tip, has an impressive sandscape-wetland complex whose communities have been summarized by Tans (1971). The rolling dunes (Fig. 6) have a full complement of beach species including beach grass, common juniper, common hairgrass, *Festuca saximontana*, false-heather, sand cress, sand cherry, beach wormwood, and jointweed. The west side of the spit is aggrading and the remains of the tug *Faithful*, beached in 1952, are now several dozen meters inland. To the east of the duneland is an even-aged stand of red pines dating from about 1879 (Swain 1986); to the north, a parklike savanna dominated by white pines

but with red and jack pines also present. The dunes enclose a large wetland, including a shallow lagoon whose southern part borders a very wet sphagnum-sedge mat with all the common bog species and also dragon-mouth, rose pogonia, shore sedge (Carex lenticularis), sooty beak-rush, pipewort, yellow-eyed grass, horned bladderwort, bog willow, and Scheuchzeria palustris. Winterberry holly, mountain-holly, sweet gale, and river horsetail are found in the shrub layer to the southeast. Farther north, rushes (Juncus canadensis and J. pelocarpus), a bulrush (Scirpus torreyi), spike-rushes (Eleocharis smallii and rarely E. robbinsii), three-way sedge, sweet gale, lance-leaved violet (Viola lanceolata), and creeping spearwort (Ranunculus reptans) grow on the wet, sandy margins of the lagoon.

Two inland bogs, each about 10 ha in size, are found on Outer Island ( $SE^{1/4}$  of  $SE^{1/4}$ , Sec. 24 and  $SE^{1/4}$ , Sec. 36). Both have been damaged by flooding by beaver impoundments, but still retain part of their scenic, savanna-like stands of old growth black spruce, white pine, tamarack, and white birch above a shrub layer of ericads, pitcher-plant, sundew, and a few sedges.

Other wetlands include several small black ash swamps which grade into cedar swamps and alder thickets as well as numerous beaver flowages, with a diverse mix of wetland species such as the manna-grasses (*Glyceria* spp.), water starwort, ragged fringed and club-spur orchids, and others too numerous to list here. One worth mentioning, however, is woodland cudweed (*Gnaphalium sylvaticum*). The only Wisconsin collection was made in 1978 along the main trail near the now-abandoned flowage in NW<sup>1</sup>/<sub>4</sub> of SE<sup>1</sup>/<sub>4</sub>, Sec. 24 (Freckmann & Fraundorf 1981). An old coastal "log roll" clearing (Sec. 30), about 1.5 km south of Lullaby camp, is re-vegetating as a white cedar thicket, and the open acid, peaty ground supports invading cranberries, round-leaved sundew, and club-spur orchid.

The eastern shoreline is rocky and grades from sandstone ledges in the north in the vicinity of Austad Bay, to low cliffs in the central bay (SE¹/4, Sec. 30; Fig. 19), to ledges again by Sec. 12 (Fig. 10). Noteworthy species here are scattered colonies of butterwort (one associated with spike trisetum); flat-leaved willow near Austad Bay; plains ragwort (Fig. 20) on ledges at several places north and south of Lullaby Logging camp; and harebell, brook lobelia, ninebark and the rush *Juncus alpinoarticulatus*.

The western and northern coasts have steep, red clay bluffs that reach 30 m in height. West of the lighthouse, marsh grass-of-parnassus is locally common in this habitat, and Mingan moonwort (*Botrychium minganense*; identification tentative) is rare; fringed brome (*Bromus ciliatus*) is also present.

At the northern tip, the lighthouse grounds have many weedy species, especially on the steep clay bank and steps in front of the station (built in 1874), as does the 11 km long cross-island trail south to the sand spit. On the eastern coast, the old Lullaby logging camp clearing (Sec. 20) has a few native (blue-eyed grass) and persistent introduced (musk mallow, *Malva moschata*) species.



FIGURE 19. Eastern coast of Outer Island, looking north from Sec. 31 across central cove, 30 July 1992.



FIGURE 20. Eastern coast of Outer Island about 600 m north of the abandoned Lullaby Logging Co. camp. Plains ragwort (*Senecio indecorus*) grows on the ledge in middle ground of the photograph, on shelves below bluff edge "krumholtz" thickets, 1 August 1992.

## Raspberry Island

Raspberry is a watchpocket miniature of an island with a very diverse flora of 266 species, or about 50% more than what would be expected from its small size. This richness is probably due to the diverse habitats found on the sandscape and bog and the presence of many exotics in the lighthouse clearing. The island is nearly surrounded by steep clay bluffs, with wedgegrass common. Sandstone outcrops only as some low cliffs just north of the lighthouse and along the northeast coast.

The pre-settlement forest was one of moderate-sized white cedar, balsam-fir, and white and yellow birch. As a government lighthouse reservation since 1864, logging was limited, although there may have been a small near-shore logging operation in 1905, and the Coast Guard cut some cedars to construct the dock in 1955 (Frederick & Rakestraw 1976). The older trees are probably 200–250 years old (Swain 1986). The four abovementioned species are still dominant in the present day forest (Dobie 1977). Scattered throughout the island are also large trees of sugar maple, hemlock, basswood, showy mountain-ash, black ash (in a few wet spots in the northwest corner), and a single large red oak along the sandscape trail.

Canada yew dominates the understory (Fig. 2; deer have never been present) and, along with abundant mountain maple and deadfalls, makes off-trail walking extremely difficult. Beaked hazelnut and red-berried elder are also common shrubs. The few widespread herbs, most present at low frequencies, include wood ferns, corn-lily, shining clubmoss, and smooth white violet. However, in the vicinity of the lighthouse and along the trail from the lighthouse to the sandscape, the understory is more open and there is a diversity of native species, especially in the numerous small ravines that cross the trail; here are found lady fern, dwarf ginseng, rosy twisted-stalk, white mandarin, nodding trillium, spikenard, false Solomon's-seal, buttercups (Ranunculus spp.), Carex leptonervia, and the small tree hop-hornbeam.

A small (1-2 ha) cuspate foreland and enclosed bog occurs in the south-eastern corner of the island (Middleton 1983). The dune vegetation is dominated by beach grass, common hairgrass, sand cherry, beach pea, smooth rose, and bearberry. The tree layer in back of the dunes includes white spruce, showy mountain-ash, white pine, quaking aspen, balsam-fir, pin cherry, and associates such as bastard-toadflax and pipsissewa.

The bog in back of the foreland is tiny but amazingly diverse. Here a small pond of open water (not noted in 1991–1992) occurred with common duckweed (*Lemna minor*), bur-reed (*Sparganium chlorocarpum*), and flat-leaved bladderwort (*Utricularia intermedia*) until at least the late 1970's. The surrounding sphagnum-sedge bog mat has many common species including sedges (*Carex canescens*, *C. echinata*, *C. lasiocarpa*, *C. limosa*, *C. utriculata*, *Eriophorum virginicum*, and *Rhynchospora alba*), rose pogonia, bog willow, common cat-tail, bog willow-herb, round-leaved sundew, boglaurel, small cranberry, tamarack, buckbean, and bog goldenrod—but no

pitcher plants. To the west, the mat grades into an alder thicket with callalily, yellow loosestrife, blue flag, and club-spur orchid.

Another wet thicket behind a low dune covered with speckled alders and tussock sedge is present on the south side of the eastern tip of the island. The diverse species mix here includes swamp cinquefoil, northern bugleweed, common skullcap, sweet gale, sticktights, bedstraw (*Galium trifidum*), reed canary-grass, blue-joint, tufted loosestrife, purple-leaved willow-herb, water-parsnip, great water dock, and Torrey's manna-grass.

The lighthouse complex on the island's west end has a diverse weed flora, including an elaborate, restored keeper's flower and vegetable garden (Lidfors 1982). Several unusual cultivated species have escaped and become well-established on the clay banks in front of the station, in particular the showy composites blanket-flower (Gaillardia pulchella) and yellow chamomile (Anthemis tinctoria). In back of the house, Japanese knotweed (Polygonum cuspidatum) has become such a troubleome weed that it must be periodically sprayed. On the forest edge just southeast of the keeper's house is a large, presumably introduced tree of the rare Pacific Northwest disjunct black hawthorn (Crataegus douglasii): in late summer its branches become covered with juicy black fruits.

## Rocky Island

Rocky Island is an oddly-shaped island with a narrow northeastern peninsula (maximum elevation: 15 m) that may be connected to the main part of the island by a sandy tombolo. The flora of 284 species is quite diverse. The western, southern, and most of the northern shores have steep clay bluffs; sandbar willow and variegated scouring-rush (*Equisetum variegatum*) are present on the western bluffs. Sandstone outcrops only as low ledges along the northern shore west of the isthmus (E<sup>1</sup>/<sub>2</sub>, Sec. 24). Two beaches are present, one 1 km long on the northern coast in the vicinity of the isthmus, and a longer one along the entire east coast from the isthmus south to the island's southeastern tip, which is a complex cuspate foreland with a filled-in bog behind (Fig. 7).

The pre-settlement forest was dominated by large yellow birch, white pine, white cedar, and balsam-fir; maples were uncommon. Logging probably began before the turn of the century but peaked from 1928–1931, when there was intensive selection for hardwoods. Commercial fishing was an important activity, and all of the present east shore cabins were associated with fishing camps until the 1950's and 1960's (M. Newman, pers. comm.). They are now used as summer cottages held for term- or life-leases.

Presently the island is dominated (Dobie 1977, Brander et al. 1978) by pole-sized white cedar, white birch, and balsam-fir, with yellow birch, sugar maple, and red maple less common, and white pine, showy mountain-ash, red oak, and basswood all uncommon. Hop-hornbeam and hemlock are rare. Dense thickets of the dominant shrub mountain maple and numerous deadfalls make walking difficult, particularly near the western and northern coasts.



FIGURE 21. Clay bluffs and cobble beaches on northern coast of Rocky Island isthmus. In the immediate right foreground is the habitat of plains ragwort. Dominant woody plants of the bluff sides are alders, white birch, white cedar, and showy mountain-ash, 4 August 1992.

Canada yew is uncommon, not surprising in view of the extremely high (15.2 killed/mi²/year) irruption era populations of deer. Deer arrived about 1946 and by 1954 there had occurred "the fastest buildup of a deer population and the fastest degeneration of a habitat I've ever seen " (B. Dahlberg, quoted in Brander & Bailey 1983). 1955 photographs of the island show dense but completely dead thickets of yew (Fig. 3). Deer were hunted and starved to extirpation by the late 1960's.

The herblayer is sparse but includes wood ferns, smooth white violet, starflower, Canada mayflower, sweet-scented bedstraw, Carex arctata, and corn-lily. Mesic forest herbs are most diverse on the rich, well-drained "shelves" above the clay bluffs in the southwestern part of the island, and include jack-in-the-pulpit, rosy twisted-stalk, nodding trillium, spikenard, false Solomon's-seal, dwarf ginseng, the grass Brachyelytrum erectum, and the sedge Carex ormostachya in its only archipelago appearance. The upland forests of the northeastern peninsula also have a significant mesic component.

Plains ragwort occurs sparingly on clay bluffs on the northern coast of the isthmus in NE<sup>1</sup>/<sub>4</sub>, Sec. 19 (Fig. 21).

The sandscape on the island's southeastern end (Fig. 7) has a large (3 ha) expanse of stabilized dunes dominated by reindeer lichens (*Cladina* spp.), beach grass, common hairgrass, false-heather, sand cherry, and beach

wormwood. Jointweed, Arabis divaricarpa, juneberry (Amelanchier sanguinea), and Festuca saximontana are also present on this "lichen heath."

A nearly open 2 ha sphagnum-ericad-sedge bog occurs northwest of the dunes; in between there are a few large white pines and a single campsite. There is no open water, but many bog species are present, including scattered small trees of tamarack, common cat-tail, cotton-grasses (*Eriophorum* spp.), white beak-rush, calla-lily, grass-pink, sweet gale, pitcher-plant, round-leaved sundew, swamp cinquefoil, marsh St. John's-wort, bog willow-herb, the common bog ericads, and the sedges *Carex echinata*, *C. lacustris*, *C. limosa*, and *C. rostrata*.

Several alder thickets are present on Rocky Island. The most prominent is a flooded white birch-conifer forest just west of the sandscape and inland from the southern coast. This "South Slough" is dominated by blue-joint and alders. Present also are bur-reed (*Sparganium chlorocarpum*), common duckweed, several manna-grasses (*Glyceria* spp.), Torrey's manna-grass, water-parsnip, *Carex retrorsa*, and tufted loosestrife. Another alder thicket is present in SW<sup>1</sup>/<sub>4</sub>, Sec. 19, on the eastern coast just south of the isthmus and north of the cabins. Labrador-tea, northern bugleweed, yellow loosestrife, bedstraw (*Galium tinctorium*), *Carex crinita*, and the rare (but here locally common) marsh horsetail (*Equisetum palustre*) are all present.

At the extreme northeastern tip of the island there is a tiny opening that is rapidly being invaded by blue-joint, rough cinquefoil, water-pepper, stinging nettle, wool-grass, fireweed, Canada thistle, and other weedy natives and exotics. This clearing was made in the 1950's as an airstrip and was the recipient of exactly one plane (M. Newman, pers. comm.).

# Sand Island

Sand Island is large, low, and generally swampy and has a moderately rich flora of 311 species. The coastline is diverse. Five narrow beaches occur: large ones at East Bay and Lighthouse Bay, and three small ones at West Bay, Justice Bay, and the northwest bay. Dune species, however, are not well-represented and beach grass occurs only at the Shaw Farm dock in the southeastern corner of the island. Geologically, Sand Island is divided between Orienta Formation sandstone in its northwestern half (including Lighthouse Point) and Devils Island Formation sandstone in the southeast. Rocky cliffs and ledges are best-developed at Swallow Point, from Lighthouse Point to Justice Bay, and from the west end of Lighthouse Bay to the northwest bay. Most of the remainder of the shoreline has low clay banks.

The pre-settlement forest is recorded as balsam-fir, birch, sugar maple, and white pine, with white cedar, spruce, and hemlock also noted in the township description (Frederick & Rakestraw 1976). On the basis of stump counts and extant large trees, Anderson et al. (1982) suggested that a mix of hardwoods and conifers dominated by yellow birch, white pine, white cedar, and hemlock originally covered about 90% of the island. The other communities, which still exist in modified form, were a 40 ha white pine-

hemlock stand on Lighthouse and Swallow Points, and a pair of black spruce-tamarack swamps totalling about 80 ha.

Norwegian fishermen-farmers began settling Sand Island in 1870. Several farms with a total cleared area of 100-150 ha were developed by World War I, at which time a community of several dozen people lived permanently on the island. Amenities during this period included a school, post office, and telephone service. However, farming declined after the war and ended by about 1930. Vacation resorts were built in 1886 at Shaw Farm and in 1910 at the West Bay (Rakestraw et al. 1976, Anderson et al. 1982). Sand Island has been repeatedly logged, with seven major operations conducted from the late 19th century until 1975. Every kind of tree was cut, beginning with high-grading for white pine, followed by yellow birch, and then white cedar and hardwoods including red oak. Because of this intensive and relatively recent logging, the poorly-drained nature of the island, and abundant Canada yew and mountain maple, cross-country walking is difficult. Presently the most important upland trees are yellow birch, balsam-fir, white birch, white cedar, and red maple. Small quantities of sugar maple and hemlock are also present, and basswood and hop-hornbeam, not noted in the present study, have been reported (Anderson et al. 1982). As noted, yew and mountain maple are dominant shrubs, reflecting the remarkable absence of present or historical populations of deer in spite of a major deeryard on the mainland only 5 km away (scattered individuals do visit; tracks of several animals were noted at the West Bay in June 1992). Beaked hazelnut, speckled alder, pin cherry, and red-osier dogwood are also important in the shrub layer. The most common herbs in the rather impoverished groundlayer are corn-lily, wood ferns, Canada mayflower, wild sarsaparilla, starflower, and marsh blue violet.

On Lighthouse Point, there is a noteworthy stand of white and yellow birches, balsam-fir, and red maple with scattered very large (up to 1 m dbh) white pines. This stand occurs on shallow soil over Orienta Formation sandstone. The herb layer includes bunchberry, white mandarin, dwarf ginseng, and Carolina spring-beauty; all can be seen along the trail from Justice Bay to the lighthouse at the northern tip of the island.

Two semi-open, boggy, sphagnous conifer swamps are present on Sand Island. The largest (45 ha) occurs between East Bay and Lighthouse Bay (center, Sec. 13), the other (25 ha), in SW<sup>1</sup>/<sub>4</sub>, Sec. 24, about 1 km southwest of East Bay dock. Both are dominated by black spruce with smaller amounts of tamarack and white birch. Understory shrubs include leather-leaf, Labrador-tea, lowbush blueberry, bog-laurel, small cranberry, twinflower, creeping snowberry, and mountain-holly. Three-leaved false Solomon's-seal, cinnamon fern, pink lady's-slipper, cotton-grasses (*Eriophorum spissum* and the more rarely seen *E. angustifolium*), and the sedges *Carex oligosperma* and *C. trisperma* are found in the herblayer.

Although walking in these fragrant swamps is pleasant, they are surrounded by muddy, formidable moats of speckled alder, with white birch, balsam-fir, and black ash also common and blue-joint and *Carex lacustris* 

dominant in the groundlayer. Other associates are northern bugleweed, calla-lily, dwarf raspberry, skunk and swamp red currants, spotted touchme-not, jack-in-the pulpit, tall manna-grass, Carex crinita, C. trisperma, enchanter's-nightshade, and goldthread. Alders have also choked and nearly closed the old road south from the East Bay dock to Shaw Farm, and wetland plants such as fringed loosestrife, joe-pye weed, late goldenrod (Solidago gigantea), and golden saxifrage occur in the ditches (farther north in drier ground along this road is a colony of the rare pale sedge Carex pallescens). Another wetland of note is a tiny, seeping, sedge marsh a few meters southwest of East Bay dock: species present include foxtail, swamp cinquefoil, spotted water-hemlock, flat-top aster (Aster umbellatus), and the sedges Carex diandra, C. lanuginosa, C. leptalea, and C. rostrata. Finally, the abandoned West Bay beaver flowage and its outlet creek have a number of interesting taxa. Sweet flag, common cat-tail, bur-reed (Sparganium chlorocarpum) and a pondweed (Potamogeton sp.) are found in the creek, and Bicknell's cranesbill (Geranium bicknellii), Torrey's mannagrass, blue flag, field-mint, spike-rush (Eleocharis obtusa), water-pepper, yellow cress, and the sedges Carex lasiocarpa and C. rostrata grow in the mud of the old flowage.

Many of Sand Island's most interesting plant species are found on the Orienta Formation sandstone ledges southeast of the lighthouse. Bird's-eye primrose and harebell are common, and spike trisetum is occasional; the shrubs ninebark, red-osier dogwood, and long-beaked willow (*Salix bebbiana*) are frequent. The lighthouse was constructed in 1882 of locally quarried stone and resembles an English cottage; common periwinkle and gill-over-the-ground (*Glechoma hederacea*) have become established along the path, and the uncommon native Bartram's juneberry is present in the brushed area southeast of the light.

Three major agricultural clearings remain on the east side of Sand Island, and these have many exotic and uncommon native species. The clearing complex between East Bay and Swallow Point (S¹/2 of SE¹/4, Sec. 13) has persistent black locust (*Robinia pseudo-acacia*), hawthorn (*Crataegus punctata*), European highbush cranberry, and, in the nearby woods, a few uncommon native species such as bottle-brush grass (*Elymus hystrix*), pagoda dogwood, and virgin's-bower (*Clematis virginiana*). Not far from this is Noring Farm (SE¹/4 of SW¹/4, Sec. 13), about 0.5 km west of East Bay campground, with goat's-beard (*Tragopogon dubius*) and other weeds. Shaw Farm at the island's southeastern tip, has an apple orchard and extensive fields (Harrington 1982) with meadow fescue (*Festuca pratensis*) and a large stand of native sweet grass (*Hierochloë odorata*).

#### South Twin Island

South Twin Island is small and low. The flora (227 species) is relatively rich, perhaps due to the many native and exotic species present on the sandscape and abandoned airstrip. Except for the prominent cuspate foreland on the western end, the shoreline is lined by clay bluffs, these low

except at the southern tip and east bay. A sandstone ledge barely outcrops at the northern tip.

The recorded pre-settlement forest included small yellow and white birches and balsam-fir; doubtless other species were present, but apparently the trees were not large. Historically, the island has long been a home to commercial fishermen, starting in the late 1880's and continuing until 1946; there may also have been agricultural activity before 1900 (M. Newman, pers. comm.). The logging history is unclear but an intensive cutting episode did occur from 1947 to 1950, when large yellow birches were removed. From 1946 to 1951, a resort and restaurant known as "Troller's Home" operated on the sandscape, but closed after the sea lamprey destroyed the sport fishery.

Presently (Heidel 1977, Brander et al. 1978) the forest is dominated by pole-sized white cedar, yellow birch, red maple, balsam-fir, and white birch. Sugar maple, hemlock, red oak, basswood, and hop-hornbeam are uncommon and restricted to the high, well-drained southern tip, where white birch is also dominant. The central and northern portions of the island are poorly-drained (there are even puddles with calla-lily and *Carex trisperma*) and have numerous deadfalls making them unpleasant to traverse.

Mountain maple, beaked hazelnut, and red-berried elder are the commonest shrubs. Canada yew is occasional, reflecting past high deer populations (5.5 killed/mi²/year). The most common herbs are starflower, wood ferns, smooth white violet, Canada mayflower, corn-lily, *Carex brunnescens*, and shining clubmoss. In addition, the more mesic south tip forest has wood millet, nodding trillium, lady fern, round-leaved dogwood, dwarf ginseng, spikenard, and jack-in-the-pulpit.

The 1 ha sandscape on the island's western tip has been greatly disturbed by human activity and has many exotics. The dominant dune species are beach grass, quack grass, false-heather, beach wormwood, and orange hawkweed. Canada goldenrod, three-toothed cinquefoil, common hairgrass, Festuca saximontana, Arabis divaricarpa, common milkweed, and sweet gale are also frequent, and a colony of starry false Solomon's-seal (Smilacina stellata) grows at the western tip of the foreland. A small alder thicket on the northwestern side has blue-joint, Carex vesicaria, blue flag, tall meadow-rue, and northern bugleweed. To the south, white and a few red pines are found near the southwestern shore.

The abandoned airstrip (built in 1960–1961) is being invaded by quaking aspen, white birch, and white pine. Its moist, sandy ditches and northeastern terminus now have numerous bog species including bog clubmoss, round-leaved sundew, tall northern green orchid, hooded ladies'-tresses, bog willow-herb, Labrador-tea, bog-laurel, balsam willow, bog goldenrod, abundant club-spur orchids, and the violets *Viola lanceolata* and *V.* × *primulifolia*. Heidel collected many of these taxa as early as 1977, illustrating how quickly bog elements can reach suitable habitats, even on small, remote islands.

# Stockton Island

Stockton Island, the largest within the National Lakeshore, has a diverse flora of 429 species. Low clay bluffs dominate this relatively low island, with sandstone outcropping in the southwestern corner (as low cliffs); as low ledges on Presque Isle Point; and, most spectacularly, as rugged bluffs in the northeast. In Sections 20 and 29 of T52N, R1W, they reach heights of 20 m above the lake, the highest on any island and rivalled only by the Squaw Bay cliffs on the Mainland Unit. They appear to have a rapid rate of erosion and no rare plants were found on them, although moonwort (Botrychium lunaria) has been collected in the past from the blufftop forest. Sandscapes are well-developed on both sides of Presque Isle Point (discussed below), at Quarry Bay as an old barrier beach, and on the northwestern coast (SW1/4 of NE1/4, Sec. 29 of T51N, R2W) as a small cuspate foreland. A narrow sand beach, known locally as "Bear Beach," extends east from the latter feature for several kilometers along the northern coast.

The pre-settlement forest was dominated by hemlock and yellow birch, with smaller areas of white pine on drier sites, white cedar and balsam-fir in boggy areas, and some sugar and red maple in well-drained uplands. Logging for pine occurred sometime before 1900, and the entire southern part was logged in the 1890's in conjunction with the operation of the brownstone quarry in Sec. 4 (Frederick & Rakestraw 1976). After logging came fires; Swain (1986) found evidence for a fire in the "Brander Bog" area (SW1/4, Sec. 19 and NE1/4 of SE1/4, Sec. 24) as early as 1915. Very extensive hardwood cutting occurred in the 1930's, and was followed or accompanied by a huge fire started by berrypickers in 1934 (Brander & Bailey 1983). By the 1940's, there were such large open areas that the island supported a population of sharp-tailed grouse. Cutting and additional fires continued into the 1950's (Wisconsin Conservation Department 1956), but with protection the island is presently nearly entirely covered by second-growth forest (Stadnyk et al. 1974, Anderson et al. 1980).

Today, hemlock is greatly reduced in importance and occurs mainly as relictual groves along the northern shore on steep slopes and in ravines, especially near Brander Bog and Trout Point. There is also a scenic, pure, coastal stand just northwest of Quarry Point at the opposite end of the island. Yellow birch showed a similar but not quite so drastic decline. White birch is now the dominant tree in many parts of the island, along with sugar and red maple. Swain and Winkler (1983) noted the increasing dominance here of these species, plus red oak, following logging; there is a nice oak stand along the Trout Point trail southwest of Brander Bog. Also frequent in the present-day forest are white cedar, balsam-fir, and quaking aspen. The latter is especially common in brushy woods northwest of Presque Isle Bay, and north and northeast of Quarry Bay.

Canada yew was reported as common and extremely dense in the forest on Presque Isle Point in 1940 by B. Dahlberg, a state deer researcher (Brander & Bailey 1983) who also reported abundant young cedar, hemlock, and mountain-ash, and only a few deer. However, the post-World War II irrup-

tion in which deer reached moderate populations (2.0 killed/mi²/year), plus fires on the main body of island, apparently reduced yew to its present negligible importance. Common shrubs today are mountain maple, beaked hazelnut, fly honeysuckle, and bush-honeysuckle. The most frequent herbs are Canada mayflower, corn-lily, wood ferns, wild sarsaparilla, big-leaved aster, rosy twisted-stalk, bunchberry, bracken fern, white violets, and round-branched ground-pine. Mesic elements are not common but can be found in forests on south-facing slopes north of Presque Isle Bay. Here occur the shrubs swamp red currant, arrow-wood viburnum, partridgeberry, and pagoda dogwood, and the herbs Solomon's-seal, false Solomon's-seal, wild oats, nodding trillium, lance-leaved grape-fern (Botrychium lanceolatum), Brachyelytrum erectum, and, in its only archipelago station, false melic grass (Schizachne purpurascens). Stadnyk et al. (1974) also have photographic records of yellow violet and bloodroot from unspecified island localities. The forest near Trout Point has yellow-trout lily, dwarf ginseng, wood millet, and the most abundant yew on the island, perhaps indicating that fires were not as severe or did not occur here.

Turning to the sandscapes, Presque Isle Point is one of the few examples of a double tombolo on the Great Lakes, and its geological history and present vegetational composition were the subject of an excellent study by Coffin (1977). Briefly, the Point was a separate island until about 5,500 years ago, when falling lake levels and twin sand spits extended south from the mainland and reached the Point. A triangular lagoon was enclosed by the spits and is today a sedge bog with black spruce, tamarack, white cedar, and alder thicket margins. Later, from 3,200 to 2,500 years before present, an outer barrier beach formed on the eastern side of the peninsula, enclosing the extant Julian Bay lagoon, whose parallel, linear beach ridge hummocks have filled in with bog species. The bog flora is rich and is rivalled in the archipelago only by the Big Bay complex on Madeline Island. All of the common species are present in the mat plus uncommon or rare taxa such as coast sedge (Carex exilis) and Michaux's sedge, both common; sooty beakrush; dragonmouth; and yellow-eyed grass. Reports (unaccompanied by vouchers) of the rare sundews *Drosera anglica* and/or *D. linearis* could not be confirmed. In the waters of the lagoon grow white and yellow waterlilies, water-shield, pondweeds, and abundant stands of the attractive green, white, and reddish Robbins' spike-rush (Eleocharis robbinsii). Between the lagoon and the lake are wet, sandy, interdunal pools (Fig. 22) on whose margins grows twig-rush, rushes (Juncus spp.), shore sedge (Carex lenticularis), and horned and small purple (Utricularia resupinata) bladderworts. In 1992, the sandy outlet of the lagoon had a tiny, perhaps transient population of lake cress (Armoracia lacustris) growing near its mouth. A second and larger, but older bog on the Point is located to the northwest of the lagoon on the other side of the inner beach ridge. The flora here is not as interesting but coast sedge was present in the mat. Finally, there is a narrow linear sedge bog just behind the beach on the northeastern side of Presque Isle Bay (SW1/4, Sec. 36).

The Julian Bay beach lake dunes are dominated by beach grass and have



FIGURE 22. Interdunal beach pool, Julian Bay, Stockton Island. In the foreground, twigrush (Cladium mariscoides) dominates, while pipewort (Eriocaulon septangulare), horned bladderwort (Utricularia cornuta), and the rush Juncus brevicaudatus are also common. The rare small purple bladderwort (U. resupinata) and threatened shore sedge (Carex lenticularis) also occur on the margin of this pool. Lake Superior is about 100 m away on the other side of the beach ridge in the background, 18 August 1992.

all the other common associates of dune communities. At the southern end there is a red pine savanna with a "lichen heath" understory that is the best remaining example of this community type in Wisconsin. Fire is a normal part of the closed beach ridge pine forest all along Presque Isle Bay; Swain and Winkler (1983) found evidence for nine separate fires during the past two centuries, most recently in 1860, 1880, 1895, and 1925. The western side of the isthmus is a red pine forest used as a campground. Ericads, especially lowbush blueberry and huckleberry, are common in the understory, and Bartram's juneberry is also present. Pink lady's-slipper is common here, while the round-leaved orchid is occasional.

There is a small but possibly calcareous wave-washed "cobblescape" on a low sandstone ledge on the southeastern shore of Presque Isle Point. Species found here are ninebark, abundant bird's-eye primrose, grass-leaved goldenrod, brook lobelia, three-toothed cinquefoil, and the sedges *Carex buxbaumii* and *C. diandra*. The ledges between the Point and Julian Bay

beach have northern ragwort (Senecio pauperculus), spike trisetum, and tufted hairgrass (Deschampsia cespitosa).

The interior of the eastern part of Stockton Island is rich in "perched" bogs. The most prominent of these is "Brander Bog," a 100 ha open conifer swamp of white cedar and black spruce (Beals 1965) that may have decreased in size since settlement (Frederick & Rakestraw 1976). All of the common bog ericads and insectivores are present here, along with the animal dispersed "lopseed sedge" (*Carex pauciflora*). Smaller perched bogs are found in SW<sup>1</sup>/<sub>4</sub> of SW<sup>1</sup>/<sub>4</sub>, Sec. 19; SE<sup>1</sup>/<sub>4</sub> of SE<sup>1</sup>/<sub>4</sub>, Sec. 23; center, Sec. 26; and N<sup>1</sup>/<sub>2</sub> of SW<sup>1</sup>/<sub>4</sub>, Sec. 30. There is also a small mat bordering the slough in back of the beach at Quarry Bay that grades into a large alder thicket and blue-joint meadow with many wetland species, including sweet flag. The slough was seriously disrupted by flooding during the storm of 1 July 1991, when many large chunks of the mat washed into the bay. There is a boggy woods at the summit of the island in SE<sup>1</sup>/<sub>4</sub> of SE<sup>1</sup>/<sub>4</sub>, Sec. 32, west of Quarry Bay.

Stockton Island has had a large population of beavers in recent decades, especially in the watersheds draining into Quarry Bay and Julian Bay. These declined with the maturation of the forest and from predation by the large black bear population (R. Anderson, pers. comm.), and no active flowages were noted during 1992 field work. The many old flowages and meadows increase local plant diversity by harboring numerous wetland species including blue-joint, Torrey's manna-grass, true manna-grasses (*Glyceria* spp.), boneset, field-mint, water-parsnip, water-hemlocks, and rough hedge-nettle (*Stachys tenuifolia*). The flowages draining into the north coast are also interesting, especially the one with its outlet in Sec. 28. Here, a boggy marsh has developed in back of a low barrier beach. The marsh is fringed with sweet gale and has scattered tamaracks and associates such as sweet flag, river horsetail, and water-plantain.

Near the mouth of one of these north coast ravines are the archeological remains of a pre-historic Amerindian hunting station (Salzer 1979). The midden here is of great ecological interest in that there are abundant moose bones present, even though there are no historic records of the animals from the archipelago. Presumably Stockton Island supported a significant population of these large ungulates at that time.

The northwestern coast cuspate foreland (Sec. 29 of T52N, R2W) is a seldom-visited Stockton Island sandscape. It has been disturbed, but many common dune species such as beach grass, juniper, and false-heather are present. The low ridge in back of the beach is forested by white pine and other species, and there is a brushy leatherleaf/sweet gale dominated swale in back of the ridge. The horsetail *Equisetum* × ferrissii and rush Juncus balticus are found in wet, sandy swales here.

Disturbed, open habitats include an old fishing or lumber camp clearing on the northwestern shore of Presque Isle Bay (NW<sup>1</sup>/<sub>4</sub> of SE<sup>1</sup>/<sub>4</sub>, Sec. 35), the Trout Point logging camp clearing (NW<sup>1</sup>/<sub>4</sub> of SW<sup>1</sup>/<sub>4</sub>, Sec. 18), the disturbed, sandy barrier beach used as a campground at Quarry Bay, and the vicinity of Presque Isle dock and ranger station.

# York Island

York Island is a small, low, pork chop-shaped island with an impoverished flora (167 species). The smaller, western peninsula rises only 6 m above the lake and may be connected to the larger eastern portion by a tombolo; this union may not have occurred until after 1824 (Strzok 1981). The island is surrounded by low clay bluffs on the southern and eastern sides, and low sandstone ledges on the northern side on both sides of the 0.8 km long isthmus beach.

The pre-settlement vegetation was dominated by white pine and hemlock; the logging history is not clear, but the pine may have been cut before the turn of the century (Frederick & Rakestraw 1976). Intensive logging for hardwood occurred in 1974, just prior to acquisition by the National Park Service. The present-day forest (Dobie 1977) is an open stand of pole-sized white birch, balsam-fir, and white cedar, with much smaller amounts of sugar maple, yellow birch, and showy mountain-ash. Red oak, reported by Dobie, was not seen in the present survey. Hemlock occurs as a small grove just west of the isthmus and as a few trees on the western peninsula. The western peninsula has an open boreal forest of balsam-fir, white spruce, white cedar, and white birch, and, much like the northern peninsula of Cat Island, there is a boggy central swale with some Labrador-tea, bog-laurel, and creeping snowberry in the understory.

The extreme dominance of Canada yew in the forest understory makes this one of the most difficult islands to hike; thickets of mountain maple are also common, especially on the western tip. Although the sand spit is less than 1.6 km from the Bayfield Peninsula (York is thus the closest "true" Apostle Island to the mainland), deer have never occurred. Because of the yew, the following few herbs occur at low frequencies: wood ferns, cornlily, starflower, smooth white violet, bunchberry, *Carex brunnescens*, and Canada mayflower. Yellow trout-lily grows in the woods near the campsites on the western end of the north beach.

The northern beach has many common dune species including beach grass, Canada wild-rye, common hairgrass, beach pea, evening-primrose, fireweed, ticklegrass, bristly sarsaparilla, and pin cherry. In back of the dune is a 2 ha shrubby willow-alder-sedge marsh. Shrubs present include many willows (Salix bebbiana, S. eriocephala, S. gracilis, S. lucida, and S. pedicellaris), speckled alder, red raspberry, skunk currant, and red-osier dogwood. The herb species are marsh fern, blue-joint, blue flag, spotted touch-me-not, sensitive fern, calla-lily, wool-grass, sticktight (Bidens cernua), northern bugleweed, skullcaps, and sedges (Carex lacustris, C. lanuginosa, C. rostrata, and C. vesicaria).

The north coast ledges support a flora with some calciphilic tendencies. Bird's-eye primrose and harebell are common, and spike trisetum, ninebark, three-toothed cinquefoil, grass-leaved goldenrod, and *Carex leptalea* are also present.

The proportion of exotics in the flora is very low (8%). Many of the weeds that Dobie (1977) reported from 1976 could not be found in

1991–1992, and probably represented short-lived populations introduced during the intensive 1974 logging operation. There is a tiny, eroding sand spit on the southeastern tip of the island. It is disturbed and supports only a few dune species, and, among the balsam-firs, a memorial cairn to the last owner's son, who was killed in Vietnam.

# CATALOG OF VASCULAR PLANTS

The following catalog includes all vascular plants known to grow without present cultivation in the Apostle Islands National Lakeshore and Madeline Island, Wisconsin. Casual escapes from gardens and plants long-persisting from cultivation are also included in the list. Following these rather broad criteria for inclusion, the only excluded species are those garden plants currently cultivated at the Raspberry Island and Michigan Island lighthouses, or at seasonally or permanently occupied cabins and houses on Madeline and other islands.

Herbaria searched for this study include the University of Wisconsin-Madison (WIS; ca. 8,000 Apostle Islands collections), University of Wisconsin-La Crosse (UWL; 5,000), Apostle Islands National Lakeshore, Bayfield (APIS; 750), Milwaukee Public Museum (MIL; 500), University of Wisconsin-Stevens Point (UWSP; 500), Iowa State University, Ames (ISC; 300), Northland College, Ashland, Wisconsin (NCAW; 300), University of Minnesota (MIN; 100), University of Wisconsin-Oshkosh (OSH; 100), Michigan Technological University, Houghton (MCTC; 100), University of Wisconsin-Superior (SUWS; 50), and Cable [Wisconsin] Natural History Museum (CABLE; 10). Herbarium abbreviations follow Holmgren et al. (1990) save for the newly-coined APIS, CABLE, and NCAW.

Familial arrangement is alphabetical within the four major groups of vascular plants (pteridophytes, gymnosperms, and monocotyledonous and dicotyledonous angiosperms). Genera and species are arranged alphabetically within families and genera, respectively. For the sake of convenience, most scientific names follow the treatment in the recent, complete atlas of Minnesota (Ownbey & Morley 1991). Infraspecific taxa are not recognized, although in a few cases (e.g., Alnus) they are used when long-familiar scientific names have been supplanted by such names. For more information on taxonomy and nomenclature we recommend that the reader refer to regional treatments by Fassett et al. (1929-1953), Iltis et al. (1957-1987), Peck and Taylor (1980), and Voss (1972, 1985). Common names follow Ownbey and Morley (1991) or in some instances Peterson and McKenny (1968), except for species listed as of special concern, threatened, or endangered by the Wisconsin Department of Natural Resources (Table 3). For these, the D.N.R.'s common name is also given. For each species, the following information is presented: scientific name; author; common name; a subjective estimate of abundance (abundant, common, fairly common, occasional, uncommon, and rare); habitat; and a voucher citation for

each island of occurrence. An asterisk preceding the scientific name indicates that the species is not considered to be native to the Apostle Islands.

Each island-voucher includes the collector's last name, collection number, and place of deposition. Unlike the islands, the Mainland Unit of the Lakeshore was not exhaustively collected for vouchers of common, as well as rare species. The following abbreviations are used for the authors' collections: **J**—Judziewicz (all collections deposited at WIS); **K**—Koch. Some sight records are included, provided they meet two criteria: there must be a voucher for the species from at least one of the islands (e.g., a single sight record for yellow lady's-slipper (*Cypripedium calceolus* L.) from Outer Island by Anderson et al. [1979] is not accepted); and, in the case of difficult groups like sedges, the observer must be a professional plant taxonomist. These sight records are not included in the floristic statistics given for each island in Table 2.

A total of 101 families, 361 genera, 795 species and 14 hybrids were recorded in this survey, including a total of 5,633 island voucher records, plus 310 Mainland Unit records. Sixteen of these species occur on the mainland but not on any of the islands. The largest families are the Cyperaceae (98 species), Compositae (79), Gramineae (60), and Rosaceae (50); Carex (71) is the largest genus. Twenty-two percent of the flora, or 173 species, are introduced. As defined by the Wisconsin Department of Natural Resources (1993) there are 37 rare species: 24 of special concern, 10 threatened, and 3 endangered.

### CHECKLIST OF VASCULAR PLANTS

### PTERIDOPHYTES

EQUISETACEAE (Horsetail Family)

Equisetum arvense L., field horsetail. Common, coasts. BASSWOOD (K 8277, UWL). BEAR (J 7057). CAT (K 12063, WIS). DEVILS (J 6667). EAGLE (J 7973). HERMIT (J 7594). IRONWOOD (J 6250). LONG (Middleton s.n., 16 Sep 1989, ISC). MADELINE (J 9887). MANITOU (J 7162). MICHIGAN (J 7279). NORTH TWIN (J 6527). OAK (Fassett 19215, WIS). OTTER (J 6421). OUTER (K 10943, UWL). RASPBERRY (Middleton s.n., 11 Jun 1980, APIS). ROCKY (J 8888). SAND (Middleton s.n., 27 May 1980, APIS). SOUTH TWIN (Heidel s.n., 8 Aug 1977, UWL). STOCKTON (J 7904). YORK (K 11497, WIS).

Equisetum ×ferrissii Clute (E. hyemale × E. laevigatum). Occasional, sand spits. CAT (J 6176). LONG (uncommon, dry dunes; Tans 1901, MIL). MADELINE (Bobb 179, NCAW, WIS). OUTER (Tans 1870, MIL). RASPBERRY (Middleton s.n., 2 Aug

1978, APIS). STOCKTON (NW spit; J 9136).

Equisetum fluviatile L., water horsetail. Uncommon, boggy marshes. MADELINE (Big Bay bog, sight record: R. H. Read). MAINLAND (Sand Bay; Cheney 6363, WIS). OUTER (S end of sand spit bog; J 9591: also in wet, peaty ground near lighthouse flowage). STOCKTON (marshy creek outlet on N shore, NE1/4 of NE1/4, Sec. 28; J 9162).

Equisetum hyemale L., common scouring-rush. Occasional, sand spits and clearings. BEAR (J 8003). CAT (NW clearing; J 9268). DEVILS (J 6654). HERMIT (J 7531). IRONWOOD (J 6215). LONG (K 8185, UWL). MADELINE (Cooper s.n., 1 Sep 1936, MIN). MANITOU (J 7301). MICHIGAN (K 11774-b, UWL). OAK (J 7757). OUTER (K 10884, UWL). ROCKY (J 6776). SOUTH TWIN (J 6832).

Equisetum palustre L., marsh horsetail. Rare, coastal wetlands. ROCKY (common, edge of alder thicket on E coast at isthmus, ca. 1 km N of dock; J 6778).

Equisetum scirpoides Michaux, dwarf scouring-rush. Uncommon, mostly on steep, forested coastal banks and ravine bottoms. HERMIT (Cheney 5397, WIS). MAIN-LAND (Cheney 6447, WIS). OAK (Lane 2731, WIS). OUTER (J 9567). STOCKTON (Cheney 5946, WIS).

Equisetum sylvaticum L., woodland horsetail. Common, woods. BASSWOOD (K 8278, WIS). BEAR (J 9721). CAT (J 9278). DEVILS (J 6632). HERMIT (J 7531). IRONWOOD (J 6215). MADELINE (Beals AP-203, WIS). MAINLAND (K 8146, UWL). MANITOU (J 7178). MICHIGAN (J 7334). NORTH TWIN (J 6535). OAK (Goessl 7923). OTTER (K 12812, WIS). OUTER (J 6342). RASPBERRY (J 8026). ROCKY (J 9720). SAND (Cheney 6165, WIS). SOUTH TWIN (J 6452). STOCKTON (Beals AP-32, WIS). YORK (J 8816).

Equisetum variegatum Schleich., variegated scouring- rush. Rare. LONG (wet, sandy flats; Tans 1902, MIL). ROCKY (W coast clay bluffs; J 6757).

### ISOETACEAE (Quillwort Family)

Isoetes macrospora Durieu, lake quillwort. BASSWOOD (Off N tip, on sand and clay bottom of Lake Superior in 4.5 m of water; Montz s.n., 1 Sep 1984, UWSP).

### LYCOPODIACEAE (Clubmoss Family)

Lycopodium annotinum L., bristly clubmoss. Common, woods. BASSWOOD (J 8132).

BEAR (J 7080). CAT (J 6147). DEVILS (Nee & Peet 1850, WIS). HERMIT (J 7613).

IRONWOOD (sight record: J). LONG (J 7948). MADELINE (Bobb 117, WIS).

MAINLAND (K 8195, UWL). MANITOU (K 13617, UWL). MICHIGAN (K 5.n., 23 Jul 1975, UWL). NORTH TWIN (J 9677). OAK (Beals AP-61, WIS). OTTER (J 8854). OUTER (K s.n., 21 Aug 1975, UWL). RASPBERRY (Middleton s.n., 1 Aug 1978, APIS). ROCKY (Clements R-9, UWL). SAND (J 6040). SOUTH TWIN (J 6459). STOCKTON (K 6987, WIS). YORK (J 8797).

Lycopodium × buttersii Abbe (L. lucidulum × L. selago). OTTER (one small colony on N-facing sandstone cliffs 5 m above water; Taylor 3638, MIL in 1977: relocated by J

Lycopodium clavatum L., running clubmoss. Common, woods. BASSWOOD (Middleton s.n., 30 Jul 1980, APIS). BEAR (J 7035). CAT (J 6098). DEVILS (Nee & Peet 1853, WIS). HERMIT (K 13398, UWL). IRONWOOD (J 6199). LONG (Cheney 5326, WIS). MADELINE (Grether 7209, WIS). MAINLAND (K 8872, UWL). MANITOU (J 7135). MICHIGAN (Team 2, UWL). NORTH TWIN (J 6575). OAK (Fassett 19216, WIS). OTTER (J 6343). OUTER (J 6078). RASPBERRY (J 8029). ROCKY (Cochrane & Cochrane 9281, WIS). SAND (J 8219). SOUTH TWIN (Heidel s.n., 4 Aug 1977, UWL). STOCKTON (Lane 2351, NCAW). YORK (J 8792).

Lycopodium complanatum L., ground-cedar. Rare, upland woods. BASSWOOD (E clearing; J 8168). LONG (J 7950).

Lycopodium complanatum x L. digitatum. Rare, upland woods. MAINLAND (Sand Bay: Chenev 6349, WIS).

Lycopodium dendroideum Michaux, round-branched ground-pine. Common, woods. BASSWOOD (J 8129). BEAR (J 7081). CAT (J 6152). DEVILS (Beals s.n., WIS). EAGLE (J 7825). HERMIT (Lane 2155, WIS). IRONWOOD (J 6294). LONG (J 8372), MADELINE (Beals AP-196, WIS). MAINLAND (K 8193, UWL). MANITOU (J 7224). MICHIGAN (Team 2, UWL). NORTH TWIN (J 6577). OAK (Taylor 4563, MIL). OTTER (J 6377). OUTER (Lane 2195, NCAW). RASPBERRY (Dobie 12, APIS). ROCKY (Cochrane & Cochrane 9282, WIS). SAND (Chenzy 6224, WIS). SOUTH TWIN (Cochrane & Cochrane 9327, WIS). STOCKTON (Taylor 3593, MIL). YORK (K 11395, UWL).

Lycopodium digitatum A. Braun, ground-cedar. Occasional, upland woods, often near old clearings. BASSWOOD (J 8165). BEAR (J 9105). CAT (J 7091). HERMIT (J 9501). IRONWOOD (Lane 2357, NCAW). LONG (J 7967). MADELINE (Freckmann 12899, UWSP). MAINLAND (K 8890, UWL). MICHIGAN (J 7313). NORTH TWIN (J 9688). OAK (Taylor 4581, APIS). OTTER (J 8872). OUTER (sight record:

J). RASPBERRY (*J* 8024). ROCKY (*Cochrane & Cochrane 9277*, MIL). SAND (*J* 8214). SOUTH TWIN (*J* 6461). STOCKTON (*J* 8486).

Lycopodium ×habereri House (L. digitatum × L. tristachyum). Rare, woods. OUTER (Sec. 2; Cottam et al. 634, WIS).

Lycopodium inundatum L., bog clubmoss. Uncommon, bogs and wet sandy-peaty areas. DEVILS (roadside through central bog; Cochrane & Cochrane 9175, WIS).
LONG (J 8351). MADELINE (Cheney 5710, WIS). MAINLAND (Little Sand Bay; K 9093, UWL). OUTER (sight records: E. Epstein & R. Anderson). RASPBERRY (sight record: R. Dobie). SOUTH TWIN (airstrip ditch; Cochrane & Cochrane 9315, WIS). STOCKTON (Julian Bay bog; J 7906).

Lycopodium lucidulum Michaux, shining clubmoss. Common, woods. BASSWOOD (J 8167). BEAR (K 13862, UWL). CAT (Team 2, UWL). DEVILS (Beals s.n., WIS). HERMIT (J 8062). IRONWOOD (Lane 2357, NCAW). MADELINE (Lane 2820, WIS). MANITOU (K 13576, UWL). MICHIGAN (J 7266). NORTH TWIN (J 6576). OAK (Beals AP-60, WIS). OTTER (J 6376). OUTER (Team 2, UWL). RASPBERRY (J 8028). ROCKY (Gerst s.n., WIS). SOUTH TWIN (Beals AP-206, WIS). STOCKTON (Taylor 3596, MIL). YORK (J 9951).

Lycopodium selago L., fir clubmoss. Rare. HERMIT (shaded rocks at N tip; J 9476). MAINLAND (N side ditch, entrance to Little Sand Bay, E<sup>1</sup>/2, Sec. 33; Taylor 4545, MIL in 1977: not relocated in 1992).

Lycopodium tristachyum Pursh, ground-cedar. Rare, partially stabilized sand dunes. LONG (Cheney 5312, WIS). MADELINE (N point beach dunes; J 9828).

## OPHIOGLOSSACEAE (Adder's-tongue Family)

Botrychium dissectum Sprengel, dissected grape-fern. Rare, woods. OUTER (on trail, Sec. 2; Doolittle s.n., 7 May 1990, APIS). SAND (Justice Bay; J 8661).

Botrychium lanceolatum (S. Gmelin) Angström, lance-leaved grape-fern. Rare, woods. HERMIT (Bruder Farm; J 9485). MAINLAND (K 8887A, UWL). MICHIGAN (Essig s.n., 30 Jul 1975, NCAW). OAK (ravine 100 m W of dock; Taylor 4587, MIL). STOCKTON (J 8493.5).

Botrychium lunaria (L.) Sw., moonwort. Rare. STOCKTON (ENE-facing sandstone cliffs, Sec. 20; Taylor 3622, MIL: not relocated in present study).

Botrychium matricariifolium A. Braun, matricary grape-fern. Occasional, deciduous woods and stabilized dunes. BASSWOOD (*J 8340*). BEAR (*J 7030*). HERMIT (quarry; *K 13431*, UWL). IRONWOOD (*J 6251*). MICHIGAN (without collector, 1 Aug 1975, NCAW). OAK (Beals AP-63, WIS). OTTER (*K 12808*, UWL). OUTER (*J 6019*). ROCKY (Cochrane & Cochrane 9273, WIS). SAND (Tryon 4063, WIS). SOUTH TWIN (sand spit; *J 6823*). STOCKTON (*K 13742*, UWL). YORK (*K 11441*, UWL).

Botrychium minganense Vict., Mingan moonwort. Rare. OAK (hemlock/hardwoods, NW<sup>1</sup>/4, Sec. 33; Middleton s.n., 8 Aug 1978, APIS). OUTER (rare in bare, eroding clay of N coast bluffs [ident. tentative]; J 6007).

Botrychium multifidum (S. Gmelin) Rupr., leathery grape-fern. Occasional, woods. BASSWOOD (J 8156). BEAR (J 9741). HERMIT (J 9481). LONG (J 8620). MADE-LINE (Lapham s.n., Sep 1858, WIS). MANITOU (Lane 2599, NCAW). MICHI-GAN (J 7461). NORTH TWIN (J 9686). OAK (Fassett 19457, WIS). OTTER (J 6367). OUTER (Doolittle s.n., APIS). RASPBERRY (sight record: R. Dobie). ROCKY (Cochrane & Cochrane 9274, WIS). SAND (J 9316). SOUTH TWIN (Middleton s.n., 8 Aug 1980, APIS). STOCKTON (J 8475). YORK (J 9945).

Botrychium simplex Hitchc., small grape-fern or least moonwort. Rare, open areas. DEVILS (N tip clearing; J 6600). MICHIGAN (Essig s.n., 30 Jul 1975, NCAW). OAK (Fassett 19681, WIS). STOCKTON (muddy spot in woods, Sec. 33; J & Van Stappen 9161, WIS).

Botrychium virginianum (L.) Sw., rattlesnake fern. Occasional, woods, often near old clearings. BASSWOOD (K 8710, UWL). BEAR (J 7098). CAT (J 6182). DEVILS (J 6703). HERMIT (J 7554). MAINLAND (K 8887B, UWL). MANITOU (J 7238). MICHIGAN (J 7303). NORTH TWIN (J 6521). OAK (Fassett 19291). OUTER

(*Team 6*, UWL). RASPBERRY (*J 6917*). ROCKY (*J 6759*). SAND (*Massopeist s.n.*, Jul 1980, UWSP). STOCKTON (*J 9144*).

Ophioglossum pusillum Raf., adder's-tongue. Rare, moist open areas; not seen in present study. OTTER (seepy, flat, open area 5 m above lake, NE side, Sec. 1; Taylor 3634, WIS). SOUTH TWIN (just N of dugout area; Middleton s.n., 8 Aug 1980, APIS).

# OSMUNDACEAE (Flowering Fern Family)

Osmunda cinnamomea L., cinnamon fern. Common, shores, wet woods, old logging trails, and coasts. BEAR (J 7020). CAT (J 6115). DEVILS (J 6679). HERMIT (Lowe s.n., 15 Jul 1975, NCAW). IRONWOOD (J 9188). MADELINE (J 8689). MANITOU (J 7233). MICHIGAN (J 9538). NORTH TWIN (J 6536). OAK (Taylor 4569, APIS). OTTER (J 8857). OUTER (Essig s.n., 18 Aug 1975, NCAW). ROCKY (Cochrane & Cochrane 9272, WIS). SAND (sight record: J). SOUTH TWIN (J 8976). STOCKTON (K 13728, UWL). YORK (J 8794).

Osmunda claytoniana L., interrupted fern. Common, shores, wet woods, and logging trails. BASSWOOD (K 8449, WIS). BEAR (J 7119). CAT (J 9236). DEVILS (J 6717). HERMIT (Lowe s.n., 16 Jul 1975, NCAW). IRONWOOD (Clements 100, UWL). MADELINE (J 8751). MAINLAND (K 8238, UWL). MANITOU (J 9070). MICHIGAN (J 7376). NORTH TWIN (J 6561). OAK (Hildebrandt 201, APIS). OTTER (J 6475). OUTER (Fraundorf s.n., 29 Jun 1978, UWSP). RASPBERRY (Dobie 66, APIS). ROCKY (J 8934). SAND (Cheney 6158, WIS). SOUTH TWIN (Essig s.n., 9 Jul 1975, NCAW). STOCKTON (Beals AP-42, WIS). YORK (K 11376, UWL).

Osmunda regalis L., royal fern. Rare, bog shrub layers or less commonly on wave-splashed sandstone. CAT (J 9271). OTTER (interior bog; J 8860). MADELINE (Big Bay bog; J 8678). OUTER (along main trail ca. 1.6 km S of lighthouse, Sec. 25; Fraundorf s.n., 9 Jul 1978, UWSP).

# POLYPODIACEAE (Polypody Family)

Adiantum pedatum L., maidenhair fern. Rare, woods. BASSWOOD (Essig s.n., 6 Aug 1975, NCAW). HERMIT (J 7559). OAK (protected cove at head of dock ravine; J 9876).

Athyrium angustum (Willd.) C. Presl, lady fern. Common, woods. BASSWOOD (Lane 2412-a, WIS). BEAR (J 7054). CAT (J 6113). DEVILS (J 6675). EAGLE (J 7820). HERMIT (J 7625). IRONWOOD (J 6201). LONG (K 7493, UWL). MADELINE (Lapham s.n., Sep 1858, WIS). MAINLAND (K 8901, UWL). MANITOU (Team 1, UWL). MICHIGAN (J 7338). NORTH TWIN (J 6542). OAK (Taylor 4558, APIS). OTTER (J 6404). OUTER (Fraundorf 3, UWSP). RASPBERRY (Middleton s.n., 11 Aug 1980, APIS). ROCKY (Dobie 167, WIS). SAND (Cheney 6223, WIS). SOUTH TWIN (J 8836). STOCKTON (Taylor 3581, MIL). YORK (J 8782).

Cheilanthes feei Moore, slender lip-fern. A rare petrophilic species, considerably N of its range limit and not seen in the present study; the following record is highly questionable. J. W. Thomson (pers. comm.) notes that some of Allen's specimens may have been mislabeled by herbarium assistants. MADELINE (without locality; C. E. Allen s.n., Aug 1892, WIS).

Cystopteris bulbifera (L.) Bernh., bulblet fern. Rare, ravine seepage slopes. OAK (N Bay stream; J 7783).

Cystopteris fragilis (L.) Bernh., fragile fern. Occasional, cliffs. EAGLE (J 7806). MAINLAND (Voss 10050, WIS). OAK (Hildebrandt 297, APIS). RASPBERRY (sight record: R. Dobie). ROCKY (Dobie 177, WIS). SAND (Swallow Point, in inaccessible crevice; sight record: J). STOCKTON (Presque Isle, on N-facing cliff; Taylor 3614, MIL).

Cystopteris ×laurentiana (Weath.) Blasdell (C. bulbifera × C. fragilis). Uncommon, cliffs. DEVILS (N tip; Taylor 3693, MIL). EAGLE (W coast cliffs; J 7840). STOCK-TON (ENE-facing sandstone cliffs, Sec. 20; Taylor 3623, MIL).

Cystopteris tenuis (Michaux) Desv. Occasional, cliffs. CAT (J 9249). DEVILS (N tip; J 6745). HERMIT (J 9493). MANITOU (J 9046). NORTH TWIN (J 9683). OTTER (N side cliffs; J 7261). OUTER (E coast rocks; J 6051).

- Dryopteris carthusiana (Villars) H.P. Fuchs, spinulose wood fern. Fairly common, woods. BASSWOOD (K 8433, UWL). CAT (J 6114). EAGLE (J 7838). HERMIT (J 9457). LONG (Tans 1905, MIL). MADELINE (Cheney 5680, WIS). MAINLAND (K 8633, UWL). MANITOU (J 9507). OAK (Taylor 4584, MIL). OTTER (J 6382). RASPBERRY (Dobie 102, WIS). ROCKY (Cochrane & Cochrane 9255, MIL). STOCKTON (K 9985-b, UWL). YORK (K 11499, UWL).
- Dryopteris cristata (L.) A. Gray, crested wood fern. Occasional, swampy woods. BASS-WOOD (Team 3, UWL). BEAR (J 9096). CAT (J 9228). DEVILS (J 8996). EAGLE (J 7823). IRONWOOD (J 9182). LONG (K 9102, WIS). MADELINE (J 8681). MANITOU (Team 5, UWL). MICHIGAN (J 9552). NORTH TWIN (J 9665). OAK (J 7744). OTTER (J 6466). OUTER (J 7496). RASPBERRY (J 6941). ROCKY (J 8915). SAND (Middleton s.n., 27 May 1980, APIS). SOUTH TWIN (J 8975). STOCKTON (J 8482). YORK (sight record: R. Dobie).
- Dryopteris expansa (C. Presl) Fraser-Jenkins & Jermy, spreading wood fern. Rare, woods. OAK (sugar maple woods, Sec. 22; Hildebrandt 360, APIS). ROCKY (open clearing, Plot 7; Team 1, 9 Jul 1975, UWL). STOCKTON (hemlock forest; Peck 79–565, UWL).
- Dryopteris intermedia (Muhlenb.) A. Gray, glandular wood fern. Abundant, woods. BASSWOOD (K 8658, UWL). BEAR (J 7060). CAT (Team 1, UWL). DEVILS (Nee & Peet 1846, WIS). HERMIT (K 13369, UWL). IRONWOOD (J 6243). MADELINE (Lapham s.n., Sep 1858, WIS). MANITOU (K 13580, UWL). MICHIGAN (Essig s.n., 30 Jul 1975, NCAW). NORTH TWIN (J 6569). OAK (Taylor 4578, MIL). OTTER (K 11569, UWL). OUTER (Tans 1868, MIL). RASPBERRY (J 6916). ROCKY (Cochrane & Cochrane 9283, WIS). SAND (Cheney 6156, WIS). SOUTH TWIN (Team 4, UWL). STOCKTON (Taylor 3626, MIL).
- Dryopteris ×triploidea Wherry (D. carthusiana×D. intermedia). Occasional, woods. HERMIT (J 7585). NORTH TWIN (Lane 2179, WIS). OAK (Taylor 4585, MIL). SOUTH TWIN (J 6445).
- Gymnocarpium dryopteris (L.) Newman, oak fern. Common, woods. BASSWOOD (Essig s.n., 25 Jun 1980, NCAW). BEAR (J 7070). CAT (Team 5, UWL). DEVILS (J 6748). EAGLE (J 7817). HERMIT (Lowe s.n., 15 Jul 1975, NCAW). IRONWOOD (J 6231). MADELINE (Cheney 5670, WIS). MAINLAND (K 8577, UWL). MANITOU (J 7124). MICHIGAN (Team 1, UWL). NORTH TWIN (J 6566). OAK (Beals AP-21, WIS). OTTER (J 6387). OUTER (Team 1, UWL). RASPBERRY (J 6915). ROCKY (Nee & Peet 1862, WIS). SAND (Cheney 6161, WIS). SOUTH TWIN (Team 4, WIS). STOCKTON (Taylor 3661, MIL). YORK (K 11434, UWL).
- Matteuccia struthiopteris (L.) Todaro, ostrich fern. Fairly common, woods. BASS-WOOD (K 8662, UWL). BEAR (J 6977). CAT (Team 1, UWL). DEVILS (Middleton s.n., 10 Jun 1979, APIS). EAGLE (J 7814). HERMIT (J 7592). IRONWOOD (J 6207). MADELINE (J 8702). MAINLAND (K 8900, UWL). MICHIGAN (J 7307). NORTH TWIN (J 6530). OAK (Hildebrandt 194, APIS). OTTER (J 6388). OUTER (Team 1, UWL). RASPBERRY (J 6850). ROCKY (J 6768). SAND (J 8242). SOUTH TWIN (J 6456). STOCKTON (J 8457). YORK (J 7675).
- Onoclea sensibilis L., sensitive fern. Common, woods. BASSWOOD (Lane 2408, NCAW). BEAR (J 7046). CAT (J 6122). DEVILS (J 6607). HERMIT (J 7566). IRONWOOD (J 6305). LONG (J 8346). MADELINE (J 8694). MAINLAND (K 8635, UWL). MANITOU (J 7142). MICHIGAN (J 7374). NORTH TWIN (J 6560). OAK (Hildebrandt 219, APIS). OTTER (J 6393). OUTER (Cottam 625, WIS). RASPBERRY (J 6849). ROCKY (Clements R-17, UWL). SAND (Cheney 6164, WIS). SOUTH TWIN (Lowe s.n., 30 Jun 1975, NCAW). STOCKTON (Taylor 3620, MIL). YORK (K 11544, UWL).
- Polypodium virginianum L., common polypody. Fairly common, cliffs and quarries; also on large stumps and logs near coast. BASSWOOD (J 8174). BEAR (J 6950). CAT (J 6186). DEVILS (J 6739). EAGLE (J 7816). HERMIT (Essig s.n., 16 Jul 1975, NCAW). IRONWOOD (J 6219). MADELINE (Cheney 5669, WIS). MAINLAND (K 8874, UWL). MANITOU (J 7189). MICHIGAN (J 7335). NORTH TWIN (J 9661). OAK (Lane 2869, WIS). OTTER (J 6313). OUTER (J 6049). RASPBERRY (Dobie

69, WIS). ROCKY (J 6820). SAND (sight record: R. Anderson). SOUTH TWIN (J 6486). STOCKTON (Beals AP-3, WIS).

Pteridium aquilinium (L.) Kuhn, bracken fern. Fairly common, dryish woods. BASS-WOOD (K s.n., 26 Jun 1975, UWL). BEAR (J 6974). CAT (Lane 2278, NCAW). DEVILS (Taylor 3702, MIL). EAGLE (sight record: J). HERMIT (Team 3, UWL). IRONWOOD (J 6266). LONG (Cheney 5342, WIS). MADELINE (J 8091). MAINLAND (K 8943, UWL). MANITOU (J 9077). MICHIGAN (Essig s.n., 30 Jul 1975, NCAW). NORTH TWIN (J 6532). OAK (GoessI 7925, MIL). OTTER (J 6385). OUTER (K 10956, UWL). RASPBERRY (Dobie 55, APIS). ROCKY (J 8904). SAND (J 8275). STOCKTON (Taylor 3609, MIL). YORK (K 11461, WIS).

Thelypteris palustris Schott, marsh fern. Occasional, wet woods, alder thickets, and bog edges. LONG (*J* 8638). MADELINE (*J* 8684). MAINLAND (*K* 8576, UWL). MANITOU (*J* 9069). MICHIGAN (*Essig s.n.*, 30 Jul 1975, NCAW). OUTER (sight records: R. Anderson, J). ROCKY (*Cochrane & Cochrane 9271*, WIS). SAND (sight

records: R. Anderson, J). STOCKTON (J 9157). YORK (J 7691).

Thelypteris phegopteris (L.) Slosson, long beech fern. Common, woods. BASSWOOD (Essig s.n., 25 Jun 1975, NCAW). BEAR (J 7067). CAT (Team 2, UWL). DEVILS (J 6749). HERMIT (J 8060). IRONWOOD (J 6232). MADELINE (K 10438, UWL). MANITOU (Team 1, UWL). MICHIGAN (Team 1, UWL). NORTH TWIN (J 6522). OAK (Beals AP-221, WIS). OTTER (J 6341). OUTER (Lane 2843, NCAW). RASPBERRY (J 6868). ROCKY (Dobie 165, WIS). SAND (Cheney 6178, WIS). SOUTH TWIN (J 6457). STOCKTON (K 8858, UWL). YORK (K 11373, APIS).

#### **GYMNOSPERMS**

## CUPRESSACEAE (Cypress Family)

Juniperus communis L., common juniper. Locally common, sand spits and bluff top clearings. BEAR (Lane 2321, WIS). CAT (J 6164). DEVILS (N tip; J 6599). HER-MIT (W point; J 9460). LONG (K 8179, WIS). MADELINE (La Pointe, Grants Point, Big Bay, N Point, Amnicon Bay; Bobb 164, WIS). MICHIGAN (J 7293). OAK (J 7726). OUTER (sand spit, lighthouse, old airstrip, and along main trail; K 10882, UWL). SOUTH TWIN (S tip; Heidel s.n., Aug 1977, UWL). STOCKTON (Cochrane & Cochrane 9246, WIS).

Thuja occidentalis L., white cedar. Fairly common, forests. BASSWOOD (Team 6, UWL). BEAR (J 7072). CAT (Team 2, UWL). DEVILS (Tans 1634, WIS). EAGLE (J 7835). HERMIT (J 7612). IRONWOOD (J 6255). LONG (K 7383, WIS: not relocated in present study). MADELINE (J 8072). MAINLAND (K 9091, UWL). MANITOU (Team 3, UWL). MICHIGAN (Team 2, UWL). NORTH TWIN (J 6585). OAK (Escoll 62, WIS). OTTER (J 6378). OUTER (Team 5, UWL). RASPBERRY (J 8025). ROCKY (Nee & Peet 1865, WIS). SAND (J 8220). SOUTH TWIN (Dorney s.n., WIS). STOCKTON (Taylor 3603, MIL). YORK (K 11482, UWL).

PINACEAE (Pine Family)

Abies balsamea (L.) Miller, balsam-fir. Often dominant, especially on smaller islands and near the lake on bluff tops. BASSWOOD (Team 5, UWL). BEAR (J 7051). CAT (K 12103). DEVILS (J 6732). EAGLE (J 7843). HERMIT (J 7611). IRONWOOD (J 6274). LONG (K 8997, UWL). MADELINE (J 8080). MANITOU (J 7258). MICHIGAN (J 7271). NORTH TWIN (J 6589). OAK (Escoll 4, MIL). OTTER (J 6381). OUTER (Team 3, UWL). RASPBERRY (J 8021). ROCKY (Team 6, UWL). SAND (Middleton s.n., 27 May 1982, APIS). SOUTH TWIN (Heidel s.n., Aug 1977, UWL). STOCKTON (J 8432). YORK (J 8779).

Larix laricina (Duroi) K. Koch, tamarack. Occasional in bogs and old beaver flowages. BEAR (summit bog; J 7016). LONG (K 8174, WIS). MADELINE (J 8089). MAIN-LAND (Rosburg s.n., 17 Sep 1988, ISC). MICHIGAN (J 7456). OTTER (J 8863). OUTER (Team 4, UWL). ROCKY (J 8899). SAND (J 8230). STOCKTON (Lane

2753, NCAW).

Picea glauca (Moench) A. Voss, white spruce. Occasional, upland woods. BASSWOOD (Team 3, UWL). BEAR (J 7055). DEVILS (Taylor 3706, MIL). HERMIT (J 7597).

LONG (*J 7960*). MADELINE (*Lapham s.n.*, Sep 1858, WIS). MANITOU (*J 9064*). MICHIGAN (*J 7423*). NORTH TWIN (*J 9663*). OAK (*J 7738*). OTTER (*J 6347*). OUTER (*Fraundorf s.n.*, 13 Jul 1978, UWSP). RASPBERRY (*J 8015*). ROCKY (*J 8929*). SAND (*J 8230*). SOUTH TWIN (*Dorney s.n.*, 1947, WIS). STOCKTON (*J 8500*). YORK (*J 8808*).

Picea mariana (Miller) Britton, Stearns, & Pogg., black spruce. Common, bogs and boreal forests. BEAR (J 6959). CAT (N tip interior swamp; J 9276). DEVILS (common; Nee & Peet 1856, WIS). MADELINE (J 9389). MICHIGAN (J 7350). OTTER (interior bog; J 8858). OUTER (J 9629). ROCKY (J 8885). SAND (J 8297). STOCKTON (Verch & Riva s.n., 23 Jul 1973, NCAW). YORK (N coast rocks; J 8807).

Pinus banksiana Lambert, jack pine. Locally common, sand spits. LONG (abundant; K 7395, WIS). MADELINE (Grants Point; J 8124: also at Big Bay). OUTER (Lowe

s.n., 12 Aug 1975, NCAW). STOCKTON (Lane 2766, WIS).

Pinus resinosa Aiton, red pine. Locally common, sand spits and bluff edges. BASS-WOOD (Team 5, UWL). BEAR (J 6964). CAT (J 6154). DEVILS (sight records from SW coast: A. Swain, T. Doolittle; trees reportedly dead by present study). HERMIT (Lane 2153, WIS). IRONWOOD (Clements 124, UWL). LONG (Cheney 5330, WIS). MADELINE (J 8092). MANITOU (K 13586, UWL). MICHIGAN (Middleton s.n., 13 Jul 1982, APIS). OAK (J 7772). OTTER (J 6312). OUTER (K 10902, UWL). SOUTH TWIN (J 6501). STOCKTON (Taylor 3658, MIL).

Pinus strobus L., white pine. Fairly common, sand spits and bluff edges; rare inland. BASSWOOD (Team 6, UWL). BEAR (J 7048). CAT (J 6155). DEVILS (common; Nee & Peet 1844, WIS). HERMIT (J 7583). IRONWOOD (J 6221). LONG (K 7543, WIS). MADELINE (J 8088). MANITOU (J 7188). MICHIGAN (Middleton s.n., 12 Jul 1982, APIS). NORTH TWIN (K 13518, UWL). OAK (J 7775). OTTER (J 8859). OUTER (K 10901, UWL). RASPBERRY (J 8035). ROCKY (J 8901). SAND (J 8229). SOUTH TWIN (J 6501). STOCKTON (Taylor 3639, MIL). YORK (J 7660).

Tsuga canadensis (L.) Carrière, hemlock. Rare to fairly common, woods. BASSWOOD (K 8467, WIS). BEAR (Lane 2324, NCAW). CAT (J 6101). DEVILS (rare, a few large trees; J 9978). HERMIT (J 7599). IRONWOOD (J 6205). MADELINE (J 8073). MAINLAND (K 8355, UWL). MANITOU (J 7202). MICHIGAN (J 7356). OAK (Goessl 7912, MIL). OTTER (J 8855). OUTER (Team 6, UWL). RASPBERRY (J 6893). ROCKY (Nee & Peet 1859, WIS). SAND (J 8282). SOUTH TWIN (J 6450). STOCKTON (Lane 2346, NCAW). YORK (K 11452, UWL).

#### TAXACEAE (Yew Family)

Taxus canadensis Marshall, Canada yew (Figs. 2-4). The dominant upland forest understory shrub on many islands, while nearly absent on others. BASSWOOD (uncommon; J 8150). BEAR (uncommon; J 7075). CAT (dominant; Team 1, UWL). DEVILS (dominant, S tip; J 6734). EAGLE (dominant; J 7861). GULL ("dense on W side;" Middleton s.n., 25 May 1979, APIS: probably extipated, not noted in 1991). HERMIT (uncommon; Team 6, UWL). IRONWOOD (dominant; J 6284). MADELINE (rare; Cheney 5697, WIS). MANITOU (uncommon; Team 1, UWL). MICHIGAN (common; K 13700, UWL). NORTH TWIN (dominant; J 6584). OAK (rare; Hildebrandt 269, APIS). OTTER (common; J 6401). OUTER (common; J 6051). RASPBERRY (dominant; K 14054, UWL). ROCKY (uncommon; J 8897). SAND (dominant; J 8198). SOUTH TWIN (uncommon; Dorney s.n., WIS). STOCKTON (uncommon; Taylor 3584, MIL). YORK (dominant; Stackler 75-886, WIS).

#### **ANGIOSPERMS**

### MONOCOTYLEDONS

# ALISMATACEAE (Water-plantain Family)

Alisma plantago-aquatica L., water-plantain. Uncommon, marshes and shores. LONG (Cheney 5381, WIS). MADELINE (Grants Point slough; J8741). OUTER (sand spit; Team 6, 13 Aug 1975, UWL). STOCKTON (sight record: J, N coast stream outlet, 1992).

Sagittaria latifolia Willd., arrowhead or duck-potato. Uncommon, marshes. BASS-

WOOD (E and W shores; J 9351). LONG (Cheney 5376, WIS). MADELINE (new marina; J 9418). MAINLAND (K 8917, UWL). STOCKTON (K 10031, UWL). Sagittaria rigida Michaux. Rare, shore. LONG (Isenhart s.n., 16 Sep 1989, ISC).

# AMARYLLIDACEAE (Amaryllis Family)

\*Narcissus poeticus L., poet's narcissus. Uncommon; long-persisting from cultivation. MADELINE (La Pointe beach town park; J 8117). MAINLAND (K 8253, UWL). MICHIGAN (lighthouse; K 13683, UWL).

## ARACEAE (Arum Family)

Acorus calamus L., sweet flag. Occasional, marshes and bogs. LONG (Cheney 5305, WIS). MADELINE (La Pointe town beach; J 9421; Goessl 7958, MIL). MAIN-LAND (Sand River bog and Little Sand Bay slough; K 8644, UWL). SAND (West Bay creek; *J 8527*). STOCKTON (N shore creek, NE1/4 of NW1/4, Sec. 28; *J 9153*).

Arisaema triphyllum (L.) Schott, jack-in-the-pulpit. Occasional, moist woods. BASS-WOOD (Cheney 5786, WIS). BEAR (J 7102). EAGLE (J 7830). HERMIT (J 7548). MADELINE (Burdick s.n., 1939, NCAW). MAINLAND (K 8219, UWL). MICHI-GAN (J 7320). OAK (J 7752). OTTER (J 6331). OUTER (J 6009). RASPBERRY (J 8950). ROCKY (Clements 979, APIS). SAND (Middleton s.n., 27 Apr 1980, APIS). SOUTH TWIN (J 6848). STOCKTON (Verch & Riva s.n., 28 Jun 1973, NCAW).

Calla palustris L., calla-lily or water-arum. Fairly common, bogs and beaver flowages. HERMIT (J 7573). LONG (K 7367, WIS). MADELINE (McCown 4, WIS). MAIN-LAND (K 8607, UWL). MICHIGAN (E tip bog; J 7366). OAK (J 8140). OUTER (J 9600). RASPBERRY (J 6936). ROCKY (Cochrane & Cochrane 9352, WIS). SAND (Cheney 6226, WIS). SOUTH TWIN (J 6446). STOCKTON (Beals AP-54, WIS). YORK (K 11543, UWL).

Symplocarpus foetidus (L.) Nutt., skunk-cabbage. Rare, swampy woods. MADELINE (Goessl 7984, MIL). STOCKTON (near quarry, Sec. 6; sight and smell record: E. Peterson, Apr 1992).

#### CYPERACEAE (Sedge Family)

Carex adusta Boott. Uncommon, clay bluffs and clearings. DEVILS (S tip; J 6669). MADELINE (Freckmann 12893, UWSP). ROCKY (Cochrane & Cochrane 9302, WIS).

Carex aenea Fern. (see C. foenea).

Carex aquatilis Wahlenb. Occasional, marshes, ravine seeps, and rock shore pools. LONG (K 7398, WIS). MADELINE (Goessl 7948, MIL). OAK (Sec. 28, with Thuja; Hildebrandt 301, APIS. N shore pool, NE1/4 of SE1/4, Sec. 22; Middleton s.n., 12

Jun 1979, APIS. SE tip; Middleton s.n., 25 Jul 1979, APIS).

Carex arctata Boott. Very common, woods. BASSWOOD (Middleton s.n., 30 Jul 1980, APIS). BEAR (J 6990). CAT (J 6148). DEVILS (J 6634). HERMIT (J 7603). IRON-WOOD (J 6223). MADELINE (J 9889). MAINLAND (K 8143, UWL). MANITOU (J 7168). MICHIGAN (J 7339). NORTH TWIN (J 6525). OAK (Hildebrandt 317, APIS). OTTER (J 8853). OUTER (J 6003). RASPBERRY (J 6882). ROCKY (Cochrane & Cochrane 9257, WIS). SAND (J 8519). SOUTH TWIN (J 6504). STOCKTON (Taylor 3617, MIL). YORK (J 7657).

Carex aurea Nutt., golden sedge. Fairly common, seeping clay bluffs; uncommon, wet sandstone ledges. BEAR (J 7000). CAT (J 6180). DEVILS (Cochrane & Cochrane 9205, MIL). MAINLAND (K 9075, UWL). MICHIGAN (J 7412). NORTH TWIN (J 6545). OAK (Cheney 5974, WIS). OTTER (J 6332). OUTER (J 6006). RASPBERRY (J 6913). ROCKY (Cochrane & Cochrane 9294, WIS). SAND (J 8325). STOCKTON

(J8488).

Carex bebbii (L. Bailey) Fern. Rare, moist area. MICHIGAN (Lane 2537, WIS).

Carex brunnescens (Pers.) Poiret. Very common, all types of woods. BASSWOOD (K 8307, WIS). BEAR (J 7076). CAT (J 6089). DEVILS (Cochrane & Cochrane 9189, WIS). EAGLE (J 7828). HERMIT (J 7584). IRONWOOD (Lane 2686, WIS). LONG (J 8378). MADELINE (J 8690). MAINLAND (K 8217, UWL). MANITOU (J 9511). MICHIGAN (J 7290). NORTH TWIN (J 6523). OAK (Lane 2218, WIS). OTTER (J

- 6316). OUTER (J 7518). RASPBERRY (J 6854). ROCKY (Middleton s.n., WIS). SAND (J 6046). SOUTH TWIN (J 6509). STOCKTON (Coffin 301, WIS). YORK (J 7706).
- Carex buxbaumii Wahlenb. Rare, moist sandstone shores. MADELINE (Cheney 5642, WIS). STOCKTON (Presque Isle Point, with Lobelia kalmii, Primula mistassinica and other calciphiles; J 8505).
- Carex canescens L. Common, bogs and marshes. BEAR (summit bog; K 11135, UWL). CAT (K 12034, UWSP). DEVILS (J 6627). LONG (K 7495, WIS). MADELINE (J 8682). MAINLAND (K 8226, UWL). MANITOU (J 9059). MICHIGAN (J 9523). OUTER (J 9590). RASPBERRY (J 6931). ROCKY (J 8898). SAND (J 8544). STOCKTON (J 8422). YORK (tombolo; K 11516, UWL).
- Carex capillaris L., hair-like sedge. Rare, bluff top conifer thickets. DEVILS (common, N tip; Cochrane & Cochrane 9206, WIS). MAINLAND (Squaw Bay cliffs; Cheney 6623, WIS).
- Carex castanea Wahlenb. Uncommon, conifer forest edges. DEVILS (N tip; Tans 1635, WIS). MADELINE (La Pointe, along Rice Street; J 8762). OUTER (Lullaby logging camp; J 6011).
- Carex chordorrhiza L.f. Rare, bog mats. MADELINE (Goessl 8042, MIL). MAIN-LAND (Sand River bog; Middleton s.n., 27 Jul 1979, APIS). ROCKY (sand spit bog; sight record: W. Tans).
- Carex communis L. Bailey. Common, dryish woods. BASSWOOD (*J 8330*). BEAR (*K 11106*, UWL). CAT (*J 6088*). HERMIT (*J 7562*). IRONWOOD (*J 6269*). MADE-LINE (*J 9382*). MAINLAND (*K 8357*, UWL). MANITOU (*J 7179*). MICHIGAN (*J 7341*). NORTH TWIN (*J 6557*). OAK (*J 8042*). OTTER (*J 6314*). OUTER (*J 7981*). RASPBERRY (*J 6887*). ROCKY (*Cochrane & Cochrane 9293*). SAND (*J 8208*). SOUTH TWIN (*J 6443*). STOCKTON (*Cochrane & Cochrane 9244*, WIS).
- Carex concinna R. Br., beautiful sedge. Rare. DEVILS (scattered, N tip bluff edges; Tans 1612, MIL).
- Carex crawfordii Fern. Fairly common, clay bluffs and clearings. DEVILS (lighthouse; Cochrane & Cochrane 9207, WIS). IRONWOOD (Lane 2375, WIS). LONG (Cheney 5392, WIS). MAINLAND (K 8366, UWL). MANITOU (J 9510). OAK (Middleton s.n., 10 Aug 1978, APIS). OTTER (N shore cliffs; K 11584, UWL). RASPBERRY (J 6870). SOUTH TWIN (Cochrane & Cochrane 9312, WIS). SAND (J 8538).
- Carex crinita Lam. (including C. gynandra Schwein.). Common, moist clearings. BASSWOOD (K 8464, UWL). BEAR (J 7031). DEVILS (J 6743). HERMIT (J 7587). LONG (J 8380). MADELINE (Freckmann 12900, UWSP). MAINLAND (K 8328, UWL). MANITOU (J 7180). MICHIGAN (J 7345). NORTH TWIN (J 6531). OAK (J 7718). OTTER (J 6320). OUTER (Lane 2175, WIS). ROCKY (J 6808). SAND (J 8522). SOUTH TWIN (Cochrane & Cochrane 9332, WIS). STOCKTON (Lane 2221, WIS). YORK (J 7667).
- Carex cristatella Britton. MAINLAND (dry roadside bank, Sand Bay; K 8371B, UWL). Carex debilis Michaux. Rare. OUTER (lighthouse woods; J 6010).
- Carex deflexa Hornem. Occasional, coniferous woods. CAT (sand spit; J 7982). DEV-ILS (Cochrane & Cochrane 9209, WIS). LONG (J & Meeker 5295, WIS). MADE-LINE (J 8695). OUTER (Austad Bay; J 9002). SAND (Justice Bay; J 8223). SOUTH TWIN (J 6442). STOCKTON (Sec. 32; J 9141). YORK (J 7664).
- Carex deweyana Schwein. Common, disturbed woods and trailsides. BASSWOOD (Middleton s.n., 12 Aug 1980, APIS). BEAR (J 7063). CAT (J 9255). DEVILS (J 6637). HERMIT (J 7560). IRONWOOD (J 6275). MADELINE (J 9366). MAINLAND (K 8345, UWL). MANITOU (J 7186). MICHIGAN (J 7315). NORTH TWIN (J 6524). OAK (Middleton s.n., WIS). OTTER (J 6406). OUTER (J 6071). RASPBERRY (J 6873). ROCKY (Cochrane & Cochrane 9288, WIS). SAND (J 8317). SOUTH TWIN (J 6495). STOCKTON (J 8454).
- Carex diandra Schrank. Uncommon, wet sandy shores and ponds; also bog mats. LONG (J 8597). MADELINE (Grants Point; J 8745). MAINLAND (Little Sand Bay slough bog; J 8512). SAND (East Bay; J 9796). STOCKTON (Presque Isle dock; J 9130).

- Carex disperma Dewey. Occasional, bog margins and conifer swamps. CAT (J 9282). DEVILS (J 6638). MADELINE (J 8710). MAINLAND (K 8380, UWL). MANITOU (J 9067). MICHIGAN (J 9521). NORTH TWIN (J 6547). OAK (Cheney 5995, WIS). OUTER (J 9613). RASPBERRY (J 6851). ROCKY (J 6772). SAND (sight record: J). SOUTH TWIN (J 6829). STOCKTON (J 9128). YORK (K 11392, UWL).
- Carex eburnea Boott, ebony sedge. Rare. MICHIGAN (common on steep, piney lake bluffs in front of lighthouse; J 7435).
- Carex echinata Murray (including C. angustior Mackenzie, C. cephalantha (L. Bailey) Bickn., and C. sterilis Willd.). Occasional, bog mats, ephemeral ponds, and wavesplashed ledges. LONG (J 8621). MADELINE (J 8671). MAINLAND (K 8229, UWL). MICHIGAN (J 7450). NORTH TWIN (E coast rock pool; J 9662). OUTER (J 9612). RASPBERRY (Dobie 107-c, WIS). ROCKY (Cochrane & Cochrane 9348, WIS). STOCKTON (K 6992, UWSP).
- Carex emoryi Dewey (det.: L.A. Standley, 1986). LONG (edge of pond; Lane 2059, WIS).
- Carex exilis Dewey, coast sedge. Sphagnum bog mats. MADELINE (common, Big Bay bog; Tans 925, MIL). STOCKTON (common, Julian Bay bog; Taylor 3660, MIL).
- Carex flava L. Rare; not seen in present survey. SOUTH TWIN (garbage pit; Middleton s.n., 8 Aug 1980, APIS).
- Carex foenea Willd. (C. aenea sensu auct.). Fairly common, clay bluffs. BASSWOOD (Team 6, UWL). BEAR (J 6972). CAT (sand spit; J 6090). DEVILS (J 6658). IRON-WOOD (J 6216). MANITOU (J 9043). OAK (N tip overlook; Middleton s.n., WIS). OTTER (Lane 2825, WIS). RASPBERRY (J 6880). ROCKY (Cochrane & Cochrane 9301, WIS). SOUTH TWIN (J 6493). STOCKTON (K 6983, WIS). YORK (J 8821).
- Carex gracillima Schwein. Occasional, upland woods. BASSWOOD (K 8476, WIS). CAT (J 9245). DEVILS (J 6736). HERMIT (J 9454). MAINLAND (K 8209, UWL). MANITOU (J 9040). OAK (J 7749). OTTER (J 6361). SAND (Cheney 6220, WIS). STOCKTON (J 9146).
- Carex houghtoniana Torrey. Occasional to fairly common, clay bluffs. BEAR (J 9727). CAT (J 6136). DEVILS (J 6674). IRONWOOD (J 6194). MADELINE (Big Bay barrier beach; Schwartz s.n., 25 Jun 1974, OSH). MAINLAND (K 8374, UWL). MANITOU (J 9080). MICHIGAN (J 7433). OAK (Middleton s.n., WIS). OTTER (J 6323). RASPBERRY (J 6898). ROCKY (J 6801). SAND (Cheney 6193). SOUTH TWIN (J 6492). YORK (tombolo; K 11459, UWL).
- Carex hystericina Willd. Rare, pond edges. LONG (W tip; J 8585). MADELINE (Grants Point; J 9802).
- Carex intumescens Rudge. Common, muddy places in woods. BASSWOOD (K 8303, WIS). BEAR (J 6966). CAT (Team 6, UWL). DEVILS (J 6626). HERMIT (J 7568). IRONWOOD (Lane 2688, WIS). LONG (J 8636). MADELINE (Lapham s.n., Sep 1859, WIS). MAINLAND (K 8359). MANITOU (Team 5, UWL). MICHIGAN (J 7340). NORTH TWIN (Lane 2185, WIS). OAK (Middleton s.n., 6 Jun 1980, APIS). OTTER (J 6355). OUTER (J 6064). RASPBERRY (J 6863). ROCKY (Lane 2811, NCAW). SAND (Cheney 6171, WIS). SOUTH TWIN (J 6489). STOCKTON (Taylor 3613, MIL). YORK (J 7708).
- Carex  $\times$  knieskernii Dewey (C. arctata  $\times$  C. castanea). Rare, rich, wooded ravine. MADELINE (N tip; J 9829).
- Carex lacustris Willd. Occasional, bogs and marshes. BASSWOOD (Rudd Farm "pond;" Middleton s.n., 30 Jul 1980, APIS). LONG (K 7505, WIS). MADELINE (J 8680). MAINLAND (Cheney 6356, WIS). MICHIGAN (sight record: W. Tans). ROCKY (Cochrane & Cochrane 9343, WIS). SAND (Middleton s.n., 27 Apr 1980, APIS). YORK (K 11496, UWL).
- Carex lanuginosa Michaux. Uncommon, springy meadows. SAND (seep at East Bay dock; J 8554). YORK (isthmus marsh; J 7690).
- Carex lasiocarpa Ehrh. Locally common, bog mats, old beaver flowages, and alder thickets. BEAR (sand spit; J 9100). LONG (Cheney 5334, WIS). MADELINE (Goessl 8043, MIL). MAINLAND (K 8620, UWL). MICHIGAN (J 9526). OAK (sand spit; Middleton s.n., 14 Jul 1978, APIS). OUTER (Fraundorf s.n., 10 Sep

1978, UWSP). RASPBERRY (Middleton s.n., 2 Aug 1978, APIS). ROCKY (bog; sight record: W. Tans). SAND (J 8554). STOCKTON (Coffin 328, WIS).

Carex lenticularis Michaux, shore sedge. Uncommon, beach and rock pool margins, wet sandy shores, and bog mats. DEVILS (occasional, W coast rocks; Tans 1603, WIS). LONG (W tip ponds and meadows, also sand cut; J 8367). OUTER (sand spit bog; J 6015). STOCKTON (occasional from Anderson Bay to Julian Bay; Coffin 351, MIN).

Carex leptalea Wahlenb. Uncommon, alder and cedar thickets bordering bogs, or rarely in rock pools. MADELINE (J 8683). MAINLAND (K 8365, UWL). OAK (N ravine; Hildebrandt 313, APIS). SAND (J 8548). STOCKTON (J 8481). YORK (N coast

rocks; J 7653).

Carex leptonervia Fern. Common, rich woods. BASSWOOD (K 8269, WIS). BEAR (J 7069). CAT (J 6120). DEVILS (J 6752). EAGLE (J 7801). HERMIT (J 7553). IRON-WOOD (J 6306). MADELINE (J 8687). MAINLAND (K 8361, UWL). MANITOU (J 7187). MICHIGAN (J 7413). NORTH TWIN (J 9664). OAK (Middleton s.n., WIS). OTTER (J 6362). OUTER (J 7522). RASPBERRY (J 6886). ROCKY (Cochrane & Cochrane 9289, WIS). SAND (J 8224). SOUTH TWIN (J 8835). STOCKTON (Cochrane & Cochrane 9249, WIS). YORK (K 11386, UWL).

Carex limosa L. Occasional, bog mats. MADELINE (J 8673). MAINLAND (Cheney 6352, WIS). MICHIGAN (J 9536). OUTER (J 9619). RASPBERRY (J 6923).

ROCKY (J 7462). STOCKTON (Coffin 311, WIS).

Carex lupulina Muhlenb. Rare. LONG (ephemeral pond margin, W tip; J 8592).

Carex merritt-fernaldii Mackenzie. Rare. BASSWOOD (Cheney 5790, WIS).

Carex michauxiana Boeckeler, Michaux's sedge. Bog mats. MADELINE (uncommon, Big Bay bog; Coffin & Engstrom 81-44, MIN). STOCKTON (common, Julian Bay bog; Goessl 7906, MIL).

Carex oligosperma Michaux, wire-grass sedge. Occasional, bog mats. MADELINE (Cooper s.n., 1 Sep 1936, MIN). OTTER (central bog; J 8867). OUTER (J 9617). SAND (Sec. 24; J 8546). STOCKTON (K 8841, UWL).

Carex ormostachya Wieg. Rare, rich woods. ROCKY (SE<sup>1</sup>/2, Sec. 25; Cochrane & Cochrane 9265, WIS).

\*Carex ovalis L. (C. leporina sensu auct., non L.; det.: A.A. Reznicek). The following is the first record of this European species from W of the U.S. eastern seabord. DEVILS (common in keeper's house lawn, 22 Jun 1991; J 6689).

Carex pallescens L., pale sedge. Rare, disturbed forest edges. MADELINE (Big Bay campground; Goessl 8247, MIL). SAND (along East Bay road; J 6041).

Carex pauciflora Light. Rare, bog mats. MICHIGAN (Tans 1640, WIS). STOCKTON (Sec. 10; J 8449).

Carex paupercula Michaux. Fairly common, bog mats. BEAR (summit bog; J 7018). DEVILS (J 6616). MANITOU (boglet; J 7229). MICHIGAN (J 7358). SAND (SW1/2, Sec. 24; J 8320). STOCKTON (Lane 2446, WIS).

Carex peckii Howe. Occasional, woods. BEAR (J 8007). CAT (J 6104). DEVILS (Tans 1605, WIS). MAINLAND (K 8346, UWL). ROCKY (Cochrane & Cochrane 9285, WIS).

Carex pedunculata Willd. Occasional, woods, especially pine woods. BASSWOOD (J 8158). CAT (K 12158, UWL). DEVILS (J 6684). HERMIT (J 8065). MADELINE (J 8076). MANITOU (J 9060). MICHIGAN (J 8058). OAK (Middleton s.n., 11 Jun 1980, WIS). OTTER (J 6321). OUTER (J 9631). RASPBERRY (J 8030). ROCKY (Cochrane & Cochrane 9287, WIS). SAND (J 8566). STOCKTON (J 8507).

Carex pensylvanica Lam. Rare, woods. LONG (K 8183, WIS; J 8356). STOCKTON (K 6996, WIS).

Carex prasina Wahlenb., drooping sedge (Figs. 23-24). OAK (locally common, ravines and seepage slopes, especially in S coast drainages; *J 9450*).

Carex projecta Mackenzie. Common, bluffs and openings. BASSWOOD (K 8472, WIS). BEAR (J 9735). CAT (J 9234). DEVILS (J 7092). HERMIT (J 7572). IRONWOOD (Lane 2689, WIS). LONG (Cheney 5377, WIS). MADELINE (J 8714). MANITOU (J 7173). MICHIGAN (K 11729, UWL). NORTH TWIN (J 9675). OAK



FIGURE 23. The state threatened drooping sedge (*Carex prasina*), locally dominant in drainageways through deciduous forests near the southeast summit of Oak Island (center of SW1/4, Sec. 34) about 2 km by trail north of the sand spit. This is the northwestern range limit for this species, which is locally common throughout the island, 23 July 1992.

(Jones s.n., WIS). OUTER (J 7513). RASPBERRY (J 6907). ROCKY (Cochrane & Cochrane 9414, WIS). SAND (J 6035). SOUTH TWIN (Cochrane & Cochrane 9323, WIS). STOCKTON (Taylor 3618, MIL). YORK (K 11387, UWL).

Carex pseudo-cyperus L. Rare, sandy shores and alder thickets. LONG (K 7540, WIS). MADELINE (Grants Point; J 8749). RASPBERRY (J 9911).

Carex retrorsa Schwein. Fairly common, alder thickets, clay bluffs, and wetland margins. IRONWOOD (J 9198). LONG (J 7918). MADELINE (Lapham s.n., Sep 1858, WIS). MICHIGAN (K 11728, UWL). OAK (Hildebrandt 215, APIS). OTTER (Bowers 11784, UWSP). ROCKY (S slough; J 8909). SAND (J 9787). STOCKTON (Tans 933, WIS).

Carex rosea Schk. Rare. RASPBERRY (woods just N of lighthouse; Dobie 32, APIS; J 6869).

Carex rostrata Stokes (see also C. utriculata). Uncommon, bogs and marshes. MICHI-GAN (sand spit bog; J 9527). ROCKY (sand spit bog; J 9691). SAND (West Bay marsh; J 8524). STOCKTON (Presque Isle; Escoll 260, WIS).

Carex rugosperma Mackenzie var. tonsa (Fern.) E. G. Voss (C. umbellata sensu auct.).
Occasional, sand spit dunes and pine woods. BEAR (sand spit; J 9747). HERMIT (dry bank at quarry; J 9496). LONG (Cheney 5349, WIS). MADELINE (J 8096).
MANITOU (J 9076). MICHIGAN (J 7295). STOCKTON (J 8465).

Carex scabrata Schwein. Rich woods and ravine bottoms. MADELINE (rare; Tans 913, WIS). MAINLAND (common, Sand Bay to Squaw Bay; Cheney 6430, WIS). MICHIGAN (rare; J 7347). OAK (common; J 8401). OTTER (occasional; J 6315). STOCKTON (uncommon; J 8474).



FIGURE 24. Distribution of drooping sedge (*Carex prasina*) in the Great Lakes region. Data compiled from state floras for Illinois, Indiana, Michigan, Ohio, and specimens at WIS.

Carex scoparia Schk. Fairly common, bluffs and clearings. BASSWOOD (Middleton s.n., 30 Jul 1980, APIS). CAT (J 9262). DEVILS (Cochrane & Cochrane 9220, WIS). IRONWOOD (Lane 2685, WIS). LONG (Levings s.n., 9 Sep 1989, ISC). MADELINE (Lapham s.n., Sep 1858, WIS). MANITOU (J 9510a). MICHIGAN (J 7378). NORTH TWIN (J 9684). OAK (Middleton s.n., 14 Jul 1978, APIS). OTTER (Lane 2824, NCAW). OUTER (J 7515). ROCKY (Lane 2810, WIS). SAND (J 6031). SOUTH TWIN (J 6838). STOCKTON (Middleton s.n., 29 Aug 1979, APIS). YORK (J 7692).

Carex stipata Willd. Common, wet openings and swamp margins. BASSWOOD (K 8414, WIS). BEAR (J 7088). CAT (K 12099, UWSP). HERMIT (J 7571). IRON-WOOD (J 9184). LONG (K 7506, WIS). MADELINE (J 8688). MAINLAND (K 8370, UWL). MANITOU (K 7217). MICHIGAN (J 7445). OAK (Middleton s.n., WIS). OTTER (J 6357). OUTER (J 7521). RASPBERRY (J 6909). ROCKY (J 6805). SAND (J 8537). SOUTH TWIN (J 6496). STOCKTON (K 6989, WIS). YORK (J 7685).

- Carex stricta Lam., tussock sedge. Fairly common, wetlands, especially creek outlet marshes and the back sides of low dune ridges with alder thickets. BASSWOOD (K 8463, WIS). HERMIT (J 9468). LONG (K 7398, WIS). MADELINE (J 8669).
  MAINLAND (K 8604, UWL). MANITOU (J 9062). MICHIGAN (J 7441). OAK (Middleton s.n., 10 Aug 1978, APIS). OTTER (central bog; J 8869). RASPBERRY (E tip alders; J 9909). ROCKY (Cochrane & Cochrane 9356, WIS). STOCKTON (Clements 348, APIS). YORK (J 9958).
- Carex tenera Dewey. Occasional, openings. BEAR (SW coast clearing; *J 6986*). CAT (*J 6128*). HERMIT (quarry clearing; *J 7632*). IRONWOOD (*K 12751*, OSH). MANITOU (NE clearing; *J 9057*). ROCKY (Cochrane & Cochrane 9261, WIS).
- Carex tenuiflora Wahlenb., sparse-flowered sedge. Rare, conifer swamp bordering bog. MADELINE (Big Bay; Tans 924, WIS).
- \*Carex tincta Fern. Rare; the following is the only Wisconsin record of this eastern species: it is probably introduced. MADELINE (weed at airport, SE 1/4, Sec. 21, 16 Jun 1992, J 8770).
- Carex trisperma Dewey. Common, swamps and bog margins. BASSWOOD (K 8453, WIS). BEAR (J 6999). CAT (J 9523). DEVILS (J 6533). HERMIT (J 7567). IRONWOOD (J 9200). LONG (J 8381). MADELINE (J 8704). MANITOU (J 7241). MICHIGAN (J 7373). NORTH TWIN (Lane 2821, NCAW). OAK (Hildebrandt 300, APIS). OTTER (J 6476). OUTER (J 9615). RASPBERRY (J 9918). ROCKY (Cochrane & Cochrane 9231, WIS). SAND (J 8545). SOUTH TWIN (J 6508). STOCKTON (Taylor 3640, MIL). YORK (J 7669).
- Carex tuckermanii Boott. Uncommon, swamps and alder thickets. CAT (J 9254). MADELINE (J 8703). MANITOU (boglet; J 7234). ROCKY (Cochrane & Cochrane 9228, WIS).
- Carex umbellata Willd. (see C. rugosperma var. tonsa).
- Carex utriculata Boott (C. rostrata var. utriculata (Boott) L. Bailey). Common, bogs and beaver flowages. BEAR (J 7019). CAT (J 9218). DEVILS (J 6681). HERMIT (J 9470). LONG (K 7557). MADELINE (J 9382). MAINLAND (K 8596, UWL). MICHIGAN (J 7365). NORTH TWIN (rock pool; J 9655). OUTER (J 9599). RASPBERRY (Dobie 2, WIS). ROCKY (Dobie 153-c, WIS). SAND (J 6029). STOCKTON (J 9127). YORK (K 11501, APIS).
- Carex vesicaria L. Fairly common, beaver flowages, alder thickets, and bogs. BEAR (J 9091). CAT (J 9279). LONG (J 8592). OTTER (J 9764). ROCKY (J 8908). SOUTH TWIN (J 6488). YORK (K 11458, UWL).
- Carex viridula Michaux. Occasional, margins of coastal sand or rock pools. CAT (E coast rocks; J 9247). LONG (sand pools; K 7516, WIS). OAK (E tip rocks; Lane 2873, NCAW). STOCKTON (Presque Isle Point; J 7901). YORK (K 11417, UWL).
- Carex vulpinoidea Michaux. Uncommon, sand ponds and ditches. IRONWOOD (Lane 2684, NCAW). LONG (J 8587). MADELINE (La Pointe; J 9422).
- Cladium mariscoides (Muhlenb.) Torrey, twig-rush. Occasional, bog mats and dune pools. MADELINE (*J 9838*). MICHIGAN (sight record: W. Tans). OUTER (*Tans s.n.*, 23 Aug 1971, WIS). STOCKTON (*Coffin 308*, WIS).
- Cyperus schweinitzii Torrey. Rare, sandy ephemeral pond margins. LONG (K 8984, WIS). MADELINE (Gerst s.n., WIS).
- Dulichium arundinaceum (L.) Britton, three-way sedge. Occasional, bog and marsh margins. LONG (*J 7921*). MADELINE (*J 8670*). MICHIGAN (*K 11727*, UWL). OUTER (*J 9624*). STOCKTON (*Lane 2433*, WIS).
- Eleocharis acicularis (L.) Roemer & Schultes. Rare, shores. LONG (Cheney 5301, WIS). STOCKTON (ledge, NW1/4 of NW1/4, Sec. 2; J 9859); N shore creek, Sec. 28; J 9163).
- Eleocharis obtusa (Willd.) Schultes. Occasional, pond margins. LONG (Mauk s.n., 16 Sep 1989, ISC). MADELINE (Gerst s.n., 31 Aug 1963, WIS). MAINLAND (Little Sand Bay; K 9072, WIS). SAND (West Bay creek; J 8531). STOCKTON (Quarry Bay lagoon; J 9175).
- Eleocharis robbinsii Oakes, Robbins' spike-rush. Shallow water of sandy lagoons.

MAINLAND (Sand River bog; Gallagher s.n., 17 Sep 1988, APIS). OUTER (rare; J 9622). STOCKTON (common, Julian Bay bog; Taylor 3651, MIL).

Eleocharis smallii Britton. Uncommon, shores. LONG (Richardson s.n., 16 Sep 1989, ISC). MAINLAND (K 9072, OSH). MICHIGAN (J 9531). NORTH TWIN (rock pool, E coast; J 6552). OUTER (sand spit lagoon; Tans s.n., 23 Aug 1971, WIS).

Eriophorum angustifolium Honck. Fairly common, bogs. DEVILS (Lane 2868, WIS). LONG (K 7499, WIS). SAND (SW1/4, Sec. 24; J 8319).

Eriophorum gracile Koch. Uncommon, bogs. MAINLAND (Sand Bay; Cheney 6370, WIS). MICHIGAN (J 9535).

Eriophorum spissum Fern. Fairly common, bogs. BEAR (summit bog; J 7007). DEV-ILS (central bog; J 6612). IRONWOOD (Lane 2698, WIS). LONG (K 7378, WIS). OUTER (Lane 2714, WIS). ROCKY (Cochrane & Cochrane 9350, WIS). SAND (J 8299). STOCKTON (J 8450).

Eriophorum tenellum Nutt. Fairly common, bogs. LONG (K 8791, UWL). MICHI-GAN (J 7983). OUTER (J 9623; K 10916, UWL). RASPBERRY (K 14014, UWL).

ROCKY (Dobie 154-a, WIS). STOCKTON (Lane 2882, WIS).

Eriophorum virginicum L. Fairly common, bogs. BEAR (summit bog; J 9739). DEV-ILS (Middleton s.n., 17 Jul 1980, APIS). LONG (K 9144, UWL). MADELINE (Cheney 5683, WIS). MICHIGAN (J 9534). RASPBERRY (Middleton s.n., APIS). ROCKY (Dobie 154-c, WIS). STOCKTON (Coffin 347, WIS).

Eriophorum viridi-carinatum (Engelm.) Fern. Rare, bogs. MADELINE (Goessl 8046,

MIL).

Rhynchospora alba (L.) Vahl, white beak-rush. Common, bogs. MADELINE (J 9837). MICHIGAN (Lane 2547, NCAW). OUTER (Fraundorf s.n., 13 Sep 1978, UWSP). RASPBERRY (Middleton s.n., 2 Aug 1978, APIS). ROCKY (Lane 2808, WIS). STOCKTON (Coffin 337, WIS).

Rhynchospora fusca (L.) Aiton f., sooty beak-rush. Occasional, bog mats. MADE-LINE (common, Big Bay bog; Tans 921, WIS: also Amnicon Bay bog). MAINLAND (uncommon, Sand River bog; J 9870). MICHIGAN (uncommon; Tans 1642, WIS; J 7448). OUTER (occasional, Sand Point lagoon; Tans 1873, WIS). STOCKTON (common, Julian Bay bog; Tans 935, WIS).

Scirpus acutus Bigelow, hard-stem bulrush. Uncommon, shallow water. LONG (W pool; Kimber s.n., 9 Sep 1989, ISC). MICHIGAN (J 9532).

Scirpus atrocinctus Fern. Uncommon, moist clearings. DEVILS (boggy road, N tip; Beals s.n., 23 Jun 1959, WIS). OUTER (Lullaby logging camp; Lane 2854, WIS).

Scirpus atrovirens Willd. Occasional, moist clearings. DEVILS (K 13985, UWL). MADELINE (Harriman 7158, OSH). MAINLAND (K 9080, UWL). OTTER (J 9760). SAND (Shaw Farm; J 8646).

Scirpus cyperinus (L.) Kunth, wool-grass. Common, moist clearings, trailsides, and marshes. BASSWOOD (J 9348). BEAR (J 9744). CAT (J 9222). DEVILS (Lane 2563, NCAW). HERMIT (J 7577). IRONWOOD (Lane 2382, NCAW). LONG (K 8998, UWL). MADELINE (Lapham s.n., Sep 1858, WIS). MAINLAND (K 8889, UWL). MANITOU (J 7177). MICHIGAN (J 7278). NORTH TWIN (J 9652). OAK (Hildebrandt 236, APIS). OTTER (J 9761). OUTER (Fraundorf s.n., 6 Aug 1978, UWSP). RASPBERRY (Middleton s.n., 2 Aug 1978, APIS). ROCKY (Dobie s.n., WIS). SAND (J 8539). SOUTH TWIN (Middleton s.n., 8 Aug 1980, APIS). STOCKTON (Coffin 326, WIS). YORK (J 7703).

Scirpus hattorianus Makino. MADELINE (roadside, Sunset Bay, Gerst s.n., 31 Aug 1963, WIS).

Scirpus hudsonianus (Michaux) Fern. Rare, wet, shaded, sandstone cliffs and bogs. DEVILS (Sec. 10; Tans 1629, WIS). MADELINE (sight record: Tans & Read 1975, p. 141). MAINLAND (near W end of inaccessible Squaw Bay cliffs, SE<sup>1</sup>/4 of SE<sup>1</sup>/4, Sec. 7 of T51N, R5W; sight record: J, 1992). STOCKTON (sight record: Tans & Read 1975, p. 141).

Scirpus microcarpus C. Presl (S. rubrotinctus Fern.). Uncommon, moist areas. LONG (Lane 2120, WIS). MADELINE (Goessl 7970, MIL). OAK (Hildebrandt 227, APIS). RASPBERRY (field N of light; Dobie 49, APIS).

Scirpus pedicellatus Fern. ROCKY (E coast dock area; Gerst s.n., 30 Aug 1963, WIS). Scirpus pungens Vahl (S. americanus Pers., misapplied), three-square. Uncommon, shallow sandy water. LONG (J 7966). STOCKTON (Julian Bay dune pools; J 7907). Scirpus subterminalis Torrey, swaying rush. Uncommon, lagoons. MADELINE (Tans

1343, WIS). OUTER (J 9621). STOCKTON (Tans 934, WIS).

Scirpus torreyi Olney. Rare. OUTER (sand spit; Tans s.n., 23 Aug 1971, WIS).

Scirpus validus Vahl, soft-stem bulrush. Uncommon, shallow water. LONG (Cheney 5414, WIS). MADELINE (Grants Point; J 8746. new marina; J 9415).

# ERIOCAULACEAE (Pipewort Family)

Eriocaulon septangulare With., pipewort. Occasional, wet, peaty shores. MADELINE (sight record: W. Tans & R.H. Read, 1971). OUTER (Lane 2507, WIS). STOCKTON (Coffin 342, WIS).

# **GRAMINEAE** (Grass Family)

\*Agropyron repens (L.) P. Beauv., quack grass. Common, beaches, sand spits, and clearings. BASSWOOD (J 9320). BEAR (J 6991). CAT (K 12068, UWL). DEVILS (J 6641). GULL (J 7876). HERMIT (J 9504). IRONWOOD (Middleton s.n., 10 Jul 1982, APIS). LONG (K 9133, UWL). MADELINE (J 8742). MAINLAND (K 8534, UWL). MANITOU (J 7161). MICHIGAN (J 7431). OAK (Fassett et al. 19600, WIS). OTTER (J 6427). RASPBERRY (J 6942). ROCKY (Cochrane & Cochrane 9347, WIS). SAND (J 9296). SOUTH TWIN (Team 3, 9 Jul 1975, UWL). STOCKTON (Kieckhefer s.n., WIS). YORK (J 8823).

Agropyron trachycaulum (Link) Malte, slender wheat-grass. Occasional, beaches and spits. LONG (K 8980, UWL). MADELINE (Cheney 5720, WIS). MICHIGAN (J 7276). OUTER (Fraundorf s.n., 2 Sep 1978, UWSP). RASPBERRY (J 6874). ROCKY (Cochrane & Cochrane 9238, WIS).

Agrostis perennans (Walter) Tuckerman, upland bent. Uncommon, openings. BEAR (J 6981). MAINLAND (K 8973A, UWL). STOCKTON (K 10827, UWL). YORK (J 7702).

Agrostis scabra Willd., hairgrass. Common, shores and sandscapes. BASSWOOD (K 14064, UWL). BEAR (J 7524). CAT (J 9220). DEVILS (J 8995). EAGLE (J 7812). HERMIT (J 7582). IRONWOOD (J 9190). LONG (K 8986, UWL). MADELINE (Lapham s.n., Sep 1858, WIS). MAINLAND (K 8905, UWL). MANITOU (J 7214). MICHIGAN (J 7363). NORTH TWIN (Lane 2470, NCAW). OAK (Middleton s.n., 25 Jul 1979, APIS). OTTER (K 11646, UWL). OUTER (K 10894, UWL). RASPBERRY (J 9903). ROCKY (J 6775). SAND (J 8650). SOUTH TWIN (Middleton s.n., 8 Aug 1980, APIS). STOCKTON (Taylor 3610, MIL). YORK (K 11377, UWL).

Agrostis stolonifera L., redtop. Common, open areas. BASSWOOD (Rudd Farm; Middleton s.n., 30 Jul 1980, APIS). BEAR (J 7525). CAT (J 9229). DEVILS (J 6690). HERMIT (J 7643). LONG (J 8623). MADELINE (Lapham s.n., Sep 1858, WIS). MAINLAND (K 8919, UWL). MANITOU (J 7243). MICHIGAN (J 7434). OAK (Hildebrandt 327, APIS). OTTER (Lane 2201, NCAW). OUTER (Fraundorf s.n., 8 Jul 1978, UWSP). RASPBERRY (J 6921). ROCKY (J 9716). SOUTH TWIN (Middleton s.n., 29 Aug 1979, APIS).

Alopecurus aequalis Sobol, foxtail. Uncommon, wet sand flats and coastal seeps. LONG (J 8383). SAND (East Bay; J 6030). STOCKTON (NW spit; J 9138).

Ammophila breviligulata Fern., beachgrass. Common, sand spits; uncommon on gravelly shores. BEAR (J 8002). CAT (J 6159). IRONWOOD (J 6261). LONG (Cheney 5368, WIS). MADELINE (Goessl 8023, MIL). MAINLAND (Sand Bay; Zenitsky s.n., 17 Sep 1988, APIS). MANITOU (rare, near N tip; J 9052). MICHIGAN (J 7272). OAK (J 8392). OTTER (J 6462). OUTER (Lane 2494, NCAW). RASPBERRY (Dobie 83, APIS). ROCKY (Dobie s.n., WIS). SAND (SE tip; J 8647). SOUTH TWIN (J 8846). STOCKTON (Coffin 385, WIS). YORK (K 11473, UWL).

\*Anthoxanthum odoratum L., sweet vernal grass. Rare, disturbed areas. MICHIGAN (old ramp to lighthouse; J 9554). OAK (sand spit campsite; J 8405).

- \*Avena sativa L., oats. Rare; weed at new construction sites. SAND (J 9303). STOCK-TON (J 9557).
- Beckmannia syzigachne (Steudel) Fern., slough-grass. MAINLAND (rare on sandy pond margin, Little Sand Bay; K 8940, UWL).
- Brachyelytrum erectum (Schreber) P. Beauv. Occasional, upland woods and ravines. BASSWOOD (J 9352). MADELINE (N tip ravines; J 9368). MAINLAND (K 8895, UWL). OAK (common; J 7713). OUTER (J 9576). ROCKY (rare; J 8933). STOCKTON (J 8476).
- Bromus ciliatus L., fringed brome. Uncommon, clearings. HERMIT (Bruder Farm, J 9479). LONG (J 8637). MADELINE (Big Bay campground; J 9836). MAINLAND (Engholm cabin site; Middleton s.n., 6 Aug 1979, APIS). OUTER (clay bluffs near lighthouse; Fraundorf s.n., 7 Sep 1978, UWSP).
- \*Bromus inermis Leysser, smooth brome. Occasional weed. BASSWOOD (W dock; *J 9326*). MADELINE (Pointe de Froide; *J 9886*). OAK (dock; *J 9429*). OUTER (lighthouse; *J 7483*). STOCKTON (*J 8495*).
- Calamagrostis canadensis (Michaux) P. Beauv., blue-joint. Common, wet meadows, bog edges, shores, and beaver flowages. BASSWOOD (Middleton s.n., 30 Jul 1980, APIS). BEAR (J 6978). CAT (NE bay; J 9217). DEVILS (Middleton s.n., 17 Jul 1980, APIS). EAGLE (J 7836). GULL ("used by nesting gulls;" Middleton s.n., 25 May 1979, APIS). HERMIT (J 7580). LONG (Cheney 5407, WIS). MADELINE (Lapham s.n., Sep 1858, WIS). MAINLAND (K 8591, UWL). MANITOU (J 7160). MICHIGAN (J 7285). NORTH TWIN (J 9648). OAK (J 9452). OUTER (J 7477). RASPBERRY (J 8953). ROCKY (Dobie 182, WIS). SAND (J 8556). SOUTH TWIN (Heidel s.n., 4 Aug 1977, UWL). STOCKTON (Jackson & Sheldon s.n., 1919, WIS). YORK (J 7694).
- Calamagrostis inexpansa A. Gray, bog reedgrass. Occasional, coasts. DEVILS (N tip; K 13978, UWL). MANITOU (S tip; Cheney 5964, WIS; J 7206). ROCKY (sand spit; Middleton s.n., 30 Jun 1982, APIS).
- Cinna latifolia (Trevir.) Griseb., wood-reedgrass. Common, upland woods. BASS-WOOD (J 9337). BEAR (J 7087). CAT (J 6099). DEVILS (S tip; J 8987). HERMIT (J 7595). IRONWOOD (J 9199). MADELINE (J 9358). MAINLAND (Iltis & Kawano 20512, WIS). MANITOU (J 7205). MICHIGAN (J 7325). NORTH TWIN (J 6540). OAK (J 7740). OTTER (J 9757). OUTER (J 9577). RASPBERRY (J 9940). ROCKY (Dobie 143, APIS). SAND (J 9311). SOUTH TWIN (J 8837). STOCKTON (J 9164). YORK (J 7707).
- \*Dactylis glomerata L., orchard-grass. Fairly common weed near clearings. DEVILS (J 7913). MADELINE (J 8722). MANITOU (J 9072). OAK (J 9428). OUTER (J 9584). ROCKY (J 8919). SAND (Shaw Farm; J 8264). SOUTH TWIN (J 9779). STOCKTON (J 8496).
- Danthonia spicata (L.) P. Beauv., wild oat-grass. Common, dryish trailsides, coastal banks, and clearings. BASSWOOD (J 8170). BEAR (J 7117). CAT (J 9265). DEVILS (J 8998). HERMIT (J 7557). IRONWOOD (J 9202). LONG (sight record: K. McEachern). MADELINE (Cheney 5722, WIS). MAINLAND (K 8922, UWL). MANITOU (J 7184). MICHIGAN (J 7408). NORTH TWIN (J 9681). OAK (Middleton s.n., 25 Jul 1979, APIS). OTTER (J 6344). OUTER (J 9570). RASPBERRY (J 6889). ROCKY (J 6794). SAND (J 8216). SOUTH TWIN (Middleton s.n., 8 Aug 1980, APIS). STOCKTON (K 8838, UWL). YORK (J 7663).
- Deschampsia cespitosa (L.) P. Beauv., tufted hairgrass. Uncommon, sand spits and dry banks. SAND (trail between Justice Bay and lighthouse; *J 8663*). STOCKTON (SE tip, Presque Isle; *Tans 929*, MIL).
- Deschampsia flexuosa (L.) Trin., common hairgrass. Common, sand spits and bluff tops. BASSWOOD (E coast; sight record: B. Middleton, 1980: not verified in present study). BEAR (SE sandscape and NE cove beach; J 7112). CAT (K 12066, UWL). DEVILS (sight record: W. Tans: not verified in present study). HERMIT (NW beach; J 7978). LONG (abundant; J & Meeker 5297, WIS). MADELINE (Harriman 7135, OSH). MAINLAND (Sand River barrier beach and Little Sand Bay; K 8942, UWL). MICHIGAN (J 7294). NORTH TWIN (S tip; J 6544). OUTER (Tans s.n., 23 Aug

- 1971, WIS). RASPBERRY (*J 6861*). ROCKY (sandscape and tombolo isthmus woods; *Cochrane & Cochrane 9305*, WIS). SOUTH TWIN (*Cochrane & Cochrane 9339*, WIS). STOCKTON (*Taylor 3662*, MIL). YORK (N beach; *J 8788*).
- \*Digitaria ischaemum (Schreber) Muhlenb., crab-grass. Rare weed. MAINLAND (Little Sand Bay; J 8576). RASPBERRY (garden; J 9926).
- Echinochloa muricata (P. Beauv.) Fern., barnyard-grass. Uncommon weed. LONG (wet shore at sand cut; *J* 8625). MADELINE (*J* 9817). MAINLAND (*K* 8941, UWL). SAND (*J* 9789).
- Elymus canadensis L., Canada wild-rye. Common on shores, especially on clay bluffs. BASSWOOD (J 9339). BEAR (J 8014). CAT (J 6126). IRONWOOD (J 9191). LONG (K 9002, UWL). MADELINE (Cheney 5726, WIS). MAINLAND (K 8911, UWL). MANITOU (J 7215). MICHIGAN (Lane 2544, WIS). OAK (Jones s.n., WIS). OUTER (Tans s.n., 23 Aug 1971, WIS). RASPBERRY (NE tip; sight record: J). ROCKY (Dobie 172, WIS). SOUTH TWIN (J 6507). STOCKTON (Kieckhefer s.n., WIS). YORK (J 8801).
- Elymus hystrix L., bottle-brush grass. Rare. SAND (alder-aspen thicket, SE1/4, Sec. 13; J 8657).
- Eragrostis, pectinacea (Michaux) Nees, lovegrass. Rare weed. MADELINE (La Pointe; J 9818).
- \*Festuca ovina L., sheep fescue. Uncommon weed. MADELINE (Goessl 8048, MIL). MAINLAND (K 8953, UWL). OUTER (J 6024).
- \*Festuca pratensis Hudson, meadow fescue. Occasional, clearings. DEVILS (S landing; J 8985). MADELINE (J 9384). OTTER (J 8876). ROCKY (J 8922). SAND (J 9792). STOCKTON (Trout Point; Middleton s.n., 15 Aug 1979, APIS).
- \*Festuca rubra L., red fescue. Occasional weed, clearings. BASSWOOD (J 9325). BEAR (J 6970). DEVILS (J 6692, 8983). MICHIGAN (J 7379). OAK (Middleton s.n., 25 Jul 1979, APIS). RASPBERRY (lighthouse; Dobie s.n., WIS). ROCKY (J 8889). SAND (J 6028). STOCKTON (J 8440).
- Festuca saximontana Rydb. Occasional, sand spits. DEVILS (Beals s.n., 24 Jun 1959, WIS). LONG (K 8987, UWL). MADELINE (Tans s.n., 5 Aug 1971, MIL). MICHIGAN (J 7296). OAK (rocks at SE tip; J 8396). OUTER (Tans s.n., 23 Aug 1971, WIS). ROCKY (J 6789). SOUTH TWIN (Middleton s.n., 8 Aug 1980, APIS).
- Glyceria borealis (Nash) Batch., northern manna-grass. Occasional, ponds, sandy pools, and ditches. LONG (*J* 8599). MADELINE (Grants Point; *J* 8750). OUTER (airstrip; *J* 9605). ROCKY (S slough; *J* 8910). STOCKON (Quarry Bay slough; *J* 9166).
- Glyceria canadensis (Michaux) Trin., rattlesnake-grass. Fairly common, marshes and alder thickets. BEAR (J 7028). CAT (J 9255.5). LONG (Levings s.n., 9 Sep 1989, ISC). MAINLAND (Rumple s.n., 3 Sep 1992, SIU). MADELINE (Lapham s.n., Sep 1858, WIS). MANITOU (J 9509). MICHIGAN (J 7368). OUTER (J 7520). RASP-BERRY (J 6906). ROCKY (Dobie 155-e, APIS). SAND (J 9307). STOCKTON (Lane 2444, WIS).
- Glyceria grandis S. Watson, tall manna-grass. Fairly common, marshes, bog edges, and beaver flowages. BASSWOOD (J 9327). BEAR (J 9743). HERMIT (J 9465). LONG (K 8818, WIS). MADELINE (J 9362). MAINLAND (K 8912, UWL). OAK (J 9453). OUTER (J 9602). ROCKY (J 9696). SAND (J 6033). STOCKTON (J 9152).
- Glyceria striata (Lam.) A. Hitchc., fowl manna-grass. Common, wetland edges and alder thickets. BASSWOOD (K 14061, UWL). BEAR (J 7095). HERMIT (J 7569). IRONWOOD (J 6198). LONG (Isenhart s.n., 9 Sep 1989, ISC). MADELINE (Lapham s.n., Sep 1858, WIS). MAINLAND (K 8912, UWL). MANITOU (coast NE of NE clearing; sight record: J). MICHIGAN (J 7332). OAK (J 7781). OUTER (J 8870). RASPBERRY (J 6910). ROCKY (Cochrane & Cochrane 9354, WIS). SAND (J 8564). SOUTH TWIN (Heidel s.n., 7 Aug 1977, UWL). STOCKTON (Falck s.n., 14 Jul 1990, UWSP).
- Hierochloë odorata (L.) P. Beauv., sweet grass. Uncommon, sandy meadows, swales, and roadsides. DEVILS (N tip clearing; Read 1609, MIL). MAINLAND: (Sand Bay to Squaw Bay; Cheney 6440, WIS). MANITOU (shoreline swale NE of fish camp; J

- 9061). ROCKY (sight record: R. Dobie: not verified in present study). SAND (Shaw Farm field; J 8308).
- \*Hordeum jubatum L., squirrel-tail grass. Rare weed. MADELINE (driveway, Sec. 29 of T51N, R2W, J 9356).
- Leersia oryzoides (L.) Sw., rice-cut grass. Rare, sandy shores. LONG (sand cut; J 8626). MADELINE (Grants Point; J 9797). SAND (sight record: R. Anderson).
- \*Lolium perenne L., ryegrass. Occasional lawn weed. MADELINE (J 9369). OUTER (lighthouse; J 7502). ROCKY (J 8920). SAND (J 9288). STOCKTON (J 9558).
- Milium effusum L., wood millet. Occasional, rich, well-drained woods. BEAR (J 6985). DEVILS (S tip; J 6628). MADELINE (N tip; J 8106). MICHIGAN (J 9550). OAK (Hildebrandt 323, APIS). OUTER (Cottam & Vogl 560, WIS). SOUTH TWIN (S tip; J 6454). STOCKTON (Trout Point; J 8415).
- Muhlenbergia mexicana (L.) Trin., muhly-grass. Rare. LONG (sand cut, bayshore; J 7922).
- Oryzopsis asperifolia Michaux, rough-leaved mountain-rice. Fairly common, sand spit pine woods; occasional in dryish woods elsewhere. BASSWOOD (J 8148). HERMIT (J 8063). MADELINE (J 8109). MAINLAND (K 8358, UWL). MANITOU (J 7129). MICHIGAN (J 7298). OAK (Middleton s.n., 28 May 1980, WIS). OUTER (K 13467, UWL). SAND (Cheney 6227, WIS). STOCKTON (Trout Point; J 8423).
- Oryzopsis pungens (Torrey) A. Hitchc. Uncommon, pine woods. BEAR (J 9750). LONG (K 8745, UWL). MADELINE (J 8090). MICHIGAN (J 7277). OUTER (J 6008).
- Panicum capillare L., witch-grass. Rare weed. MADELINE (La Pointe; J 9884). MAINLAND (Little Sand Bay; J 8577).
- Panicum columbianum Scribner. Rare, weedy places. LONG (light station lawn; K 8813, UWSP). OUTER (sand spit; Fraundorf s.n., 2 Sep 1978, UWSP).
- Panicum depauperatum Muhlenb. Rare weed. CAT (NW clearing; J 9266). LONG (light station lawn; K 8807, UWL).
- Panicum lanuginosum Elliott (P. acuminatum Sw. var. fasciculatum (Torrey) A. A. Beetle; P. implicatum Britton). Occasional, clearings and shores. BASSWOOD (Rudd Farm; Middleton s.n., 30 Jul 1980, APIS). LONG (Cheney 5318, WIS). MADELINE (Cheney 5638, WIS). OAK (Hildebrandt 328, APIS). OUTER (S¹/2, Sec. 24; Fraundorf s.n., 9 Jul 1978, UWSP. Lullaby logging camp, J 6027). SOUTH TWIN (J 9025). STOCKTON (Lane 2453, WIS. NW spit; J 9137).
- \*Phalaris arundinacea L., reed canary-grass. Fairly common, wetland edges, old roadsides, and clearings. BASSWOOD (K 8715, UWL). BEAR (J 7105). CAT (J 9266). DEVILS (J 6629). GULL (J 7891). HERMIT (J 7556). LONG (K 8801, UWL). MADELINE (J 8715). MAINLAND (K 9084, UWL). MANITOU (J 7196). OAK (J 7760). OTTER (J 7482). OUTER (J 9586). RASPBERRY (J 6912). ROCKY (J 8916). SAND (J 8563). SOUTH TWIN (J 6837). STOCKTON (J 8441). YORK (J 8820).
- \*Phleum pratense L., timothy. Fairly common, clearings. BASSWOOD (J 9324). BEAR (J 7033). CAT (J 9226). DEVILS (J 6652). GULL (Lane 2788, NCAW). HERMIT (J 7642). IRONWOOD (Clements 71, UWL). LONG (J 8627). MADELINE (J 8721). MAINLAND (K 8570, UWL). MANITOU (J 7155). MICHIGAN (J 7407). OAK (Hildebrandt 319, APIS). OTTER (J 9754). OUTER (K 10958, WIS). RASPBERRY (Dobie 63, WIS). ROCKY (Cochrane & Cochrane 9296). SAND (J 8263). SOUTH TWIN (J 6831). STOCKTON (Lane 2342, NCAW).
- Phragmites australis (Cav.) Steudel, reed. Uncommon, moist inland sides of barrier beaches. LONG (J 7939). OUTER (J 7505).
- Poa alsodes A. Gray. Rare. MADELINE (edge of Big Bay bog alder thicket, NE<sup>1</sup>/4 of NE<sup>1</sup>/4, Sec. 24; *J* 8699). MAINLAND (Little Sand Bay, Sec. 33; *Iltis & Kawano 20499*, WIS). OAK (rich ravine, Sec. 34-35; *J* 8402).
- \*Poa annua L., annual blue grass. Fairly common, disturbed areas (especially trails). BASSWOOD (J 8142). CAT (J 9018). DEVILS (J 6753). EAGLE (J 7979). GULL (common; J 7895). LONG (J 8362). MADELINE (J 8078). MAINLAND (K 8957, UWL). MANITOU (J 8050). MICHIGAN (J 7122). OAK (J 8394). OTTER (J 6411).

OUTER (sight record: J). RASPBERRY (J 6865). ROCKY (Cochrane & Cochrane 9263, WIS). SAND (J 8207). SOUTH TWIN (J 8831). STOCKTON (J 8433).

\*Poa compressa L., Canada blue grass. Common, sand spits and clay bluffs. BASS-WOOD (J 8169). BEAR (J 7108). CAT (J 6143). DEVILS (J 6602). HERMIT (J 7628). IRONWOOD (J 6287). LONG (J 7930). MADELINE (Goessl 8045, MIL). MAINLAND (K 8338, UWL). MANITOU (J 7164). MICHIGAN (J 7458). OAK (Hildebrandt 331, APIS). OTTER (J 6422). OUTER (J 6025). RASPBERRY (J 8955). ROCKY (Middleton s.n., 29 Jun 1982, APIS). SAND (J 6044). SOUTH TWIN (J 6825). STOCKTON (Falck s.n., 23 Jul 1990, UWSP). YORK (J 8780).

Poa nemoralis L. Fairly common, clay bluffs and sandstone ledges. BASSWOOD (S tip; J 9338). BEAR (J 6971). CAT (J 9221). DEVILS (J 8999). EAGLE (J 7808). HERMIT (J 7646). MADELINE (Tans 916, MIL). NORTH TWIN (J 7977). RASP-

BERRY (J 6896). ROCKY (J 6756). STOCKTON (J 7905).

Poa palustris L., fowl meadow-grass. Common, wetlands. BASSWOOD (J 9349). BEAR (J 7024). CAT (J 9014). DEVILS (J 6606). EAGLE (J 7848). GULL (mesic central ravine; K 13916, UWL). HERMIT (J 7615). IRONWOOD (J 9179). LONG (K 9009, UWL), MADELINE (J 9363), MANITOU (J 7213), MICHIGAN (Tans 1643, WIS). NORTH TWIN (J 9653). OAK (J 7771). OTTER (J 9776). OUTER (Cottam & Vogl 645, WIS). RASPBERRY (J 6897). ROCKY (Cottam & Vogl 600, WIS). SAND (J 9306). SOUTH TWIN (J 6505). STOCKTON (Lane 2341, NCAW). YORK (J 7700).

Poa pratensis L., Kentucky blue grass. Fairly common, clearings. BEAR (sand spit; Middleton s.n., 18 Jun 1979, APIS). CAT (J 9012). DEVILS (Cochrane & Cochrane 9199, WIS). GULL (J 7887). HERMIT (Lane 2151, NCAW). IRONWOOD (Middleton s.n., 10 Jul 1979, APIS). MADELINE (J 8716). MANITOU (J 7156). MICHI-GAN (J 7409). NORTH TWIN (J 6515). OAK (Goessl 7892, MIL). OTTER (J 8877). OUTER (J 6432). RASPBERRY (Middleton s.n., 20 Jun 1982, APIS). ROCKY (Cochrane & Cochrane 9237, WIS). SAND (J 8252). SOUTH TWIN (J 8832). STOCKTON (J 8419).

Poa saltuensis Fern. & Wieg. Rare, sugar maple woods. MADELINE (florets all fallen, ident. tentative; Goessl 8242, MIL). STOCKTON (SW1/4 of SW1/4, Sec. 25; J 8460.

SW1/4 of SW1/4, Sec. 30; J 8489).

Schizachne purpurascens (Torrey) Swallen, false melic grass. Rare, upland woods. MAINLAND (Cheney 6434, WIS). STOCKTON (NW Presque Isle Bay and NE tip; J 8452).

\*Setaria glauca (L.) P. Beauv., yellow foxtail. Rare weed. MADELINE (La Pointe; J

9816). MAINLAND (K 8952, UWL).

Sphenopholis obtusata (Michaux) Scribner (including S. intermedia (Rydb.) Rydb.), wedge-grass. Common, clay bluffs; occasional, sandstone ledges. BEAR (J 9730). HERMIT (J 9499). LONG (J 8594). MICHIGAN (J 7351). NORTH TWIN (J 9659). OAK (J 9424). OTTER (J 9768). OUTER (J 9571). RASPBERRY (J 6899). ROCKY (J 9717). SAND (J 9780). STOCKTON (Tans 133, MIL). YORK (J 9943).

Torreyochloa pallida (Torrey) Church, Torrey's manna- grass. Locally common, mud of old beaver flowages and creek outlets. MADELINE (Goessl 8245, MIL). RASP-BERRY (J 9912). ROCKY (S slough; J 9697). SAND (West Bay creek; J 8533).

STOCKTON (Quarry Bay slough; J 9167).

Trisetum spicatum (L.) K. Richter, spike trisetum (Fig. 25). Uncommon, shaded sandstone ledges, or rarely on steep clay banks. BASSWOOD (shore E of McCloud Farm; Middleton s.n., 12 Aug 1980, APIS: not relocated in present study). BEAR (occasional, N and NE coast rocks; rare, W tip clay bluffs; J 6973). HERMIT (rare, N tip; J 9478). IRONWOOD (occasional, N coast; J 7912). MADELINE (Steamboat Point and Big Bay Point; Tans 1341, WIS). MANITOU (N tip; J 9048). OTTER (occasional, N coast; J 7260). OUTER (rare, E coast; sight record: J, 30 Jul 1992). SAND (rare, ledges SE of lighthouse; J 9781). STOCKTON (Presque Isle Point; Cochrane & Cochrane 9242, WIS. Trout Point; Middleton s.n., APIS). YORK (occasional, N coast; J 7661).



FIGURE 25. The threatened spike trisetum (*Trisetum spicatum*) growing on a semi-shaded sandstone ledge on the western end of the northeastern cove of Bear Island. This grass is occasional in such habitats throughout the archipelago, 8 July 1991.

# HYDROCHARITACEAE (Frogs-bit Family)

Elodea canadensis Michaux, waterweed. Rare, pools. LONG (K 10515, UWL). MADE-LINE (sight record: W. Tans & R. H. Read, 1971). MAINLAND (Sand River; Gabrey s.n., 17 Sep 1988, ISC).

Elodea nuttallii (Planchon) H. St. John. Rare, pools. LONG (K 9104, UWL). Vallisneria americana Michaux, tape-grass or wild-celery. Uncommon, ponds and in open lake. LONG (Claassen s.n., 9 Sep 1989, ISC). MADELINE (lagoon at Chebomnicon Bay; J 9401).

# IRIDACEAE (Iris Family)

Iris versicolor L., blue flag. Common, wetlands. BASSWOOD (K 8462, UWL). BEAR (J 7017). CAT (J 6139). DEVILS (J 6740). HERMIT (J 7576). IRONWOOD (Lane 2674, WIS). LONG (Siegwarth s.n., 9 Sep 1989, ISC). MADELINE (J 8672). MAINLAND (K 8383, UWL). MANITOU (J 7153). MICHIGAN (J 7309). OAK (Hildebrandt 239, APIS). OUTER (Lane 2159, NCAW). RASPBERRY (Dobie 24, WIS). ROCKY (Team 1, UWL). SAND (J 8541). SOUTH TWIN (J 6827). STOCKTON (Coffin 371, WIS). YORK (J 8796).

Sisyrinchium montanum E. Greene, blue-eyed grass. Occasional, old clearings. BASS-WOOD (McCloud Farm; Middleton s.n., 12 Aug 1980, APIS; K 8285, UWL). BEAR (steep bank, W clearing; J 6984). IRONWOOD (sand spit; K 12747, UWL). MADE-LINE (fairly common, old fields; Beals AP-205, J 8726, WIS). MAINLAND (K 8232, UWL). MANITOU (NW clearing; Frostman 510, APIS). OUTER (Lullaby logging camp; J 6013).

Sisyrinchium strictum E. Bickn., blue-eyed grass. (det.: A. Cholewa and D. Henderson.) Rare. DEVILS (N tip clearing; Lane 2742, Cochrane & Cochrane 9208, WIS).

# JUNCACEAE (Rush Family)

Juncus alpinoarticulatus Chaix (J. alpinus Villars). Occasional, acid peaty shores. LONG (Cheney 5370, WIS). MADELINE (Cheney 5579, WIS). OUTER (K 10961, UWL).

Juncus balticus Willd. Locally common, wet dune swales. LONG (Cheney 5387, WIS).
MADELINE (Cheney 5724, WIS). MAINLAND (Sand River; Middleton s.n., 27 Jul 1979, APIS). OAK (J 7723). STOCKTON (Anderson Bay clearing; J 8494. NW spit; J 9135).

Juncus brevicaudatus (Engelm.) Fern. Fairly common, acid sandy shores, or less common near rock pools or on clay bluffs. DEVILS (J 9001). LONG (Cheney 5385, WIS). MADELINE (Grants Point; J 9799). MAINLAND (K 8904, UWL). OUTER (J 7472). SOUTH TWIN (Cochrane & Cochrane 9316, WIS). STOCKTON (J 7899).

Juncus bufonius L., toad rush. Occasional, shores and moist, disturbed areas. BASS-WOOD (Cheney 5792, WIS). DEVILS (N tip; K 13968, UWL). HERMIT (J 7633). MADELINE (Kron Road; J 9378). OAK (S shore ravine, Sec. 3; Hildebrandt 336, APIS). STOCKTON (K 10021, UWL).

Juncus canadensis J. Gay. Locally common, bog margins and peaty shores. LONG (Meeker & Elias s.n., 21 Aug 1991, WIS). MADELINE (Houghton s.n., 7-11 Aug 1832, MICH; Cheney 5639, WIS). MICHIGAN (J 9529). OUTER (Tans s.n., 23 Aug 1971, WIS). STOCKTON (common, Julian Bay; Taylor 3656, MIL).

Juncus dudleyi Wieg. Occasional, shores and trails. BASSWOOD (Cheney 5789, WIS). LONG (Meeker & Elias s.n., 21 Aug 1991, WIS). OAK (E banks; Lane 2871, NCAW). STOCKTON (Quarry Bay rock ledges; J 9842).

Juncus effusus L., common rush. Common, wetland edges and wet openings. BASS-WOOD (Lane 2416, WIS). BEAR (J 7106). CAT (J 6134). DEVILS (J 8980). HER-MIT (J 9462). IRONWOOD (J 6197). LONG (K 9134). MADELINE (J 8074). MAINLAND (K 8903). MANITOU (J 9505). MICHIGAN (J 7172). OAK (Hildebrandt 221, APIS). OTTER (J 6440). OUTER (Tans 26, WIS). ROCKY (J 6804). SAND (J 8226). SOUTH TWIN (J 6821). STOCKTON (Verch & Riva s.n., 23 Aug 1973, NCAW).

Juncus nodosus L. Uncommon, wetland edges. LONG (Cheney 5371, MIL). MADE-LINE (marina; J 9809).

Juncus pelocarpus E. Meyer. Uncommon, sandy-peaty shores. OUTER (sand spit lagoon edge; Tans s.n., 23 Aug 1971, WIS). STOCKTON (sandy slough behind lake; K 10021, UWSP).

\*Juncus squarrosus L., heath rush. Locally common. DEVILS (wet, sandy-peaty path edges near lighthouse; Tans 1687, MIL); first collected in 1977 and correctly ident. by T. S. Cochrane in 1980, this Greenland and N European species was well-established by 1992. This represents the first known collection from North America outside of Greenland.

Juncus tenuis Willd., path rush. Common, trails and clearings. BASSWOOD (J 9333).

BEAR (J 9723). CAT (J 7120). DEVILS (Cochrane & Cochrane 9215, WIS). HER-MIT (J 7974). IRONWOOD (Lane 2376, NCAW). MADELINE (Lapham s.n., Sep 1858, WIS). MAINLAND (K 8524, UWL). MANITOU (J 7207). MICHIGAN (J 7432). OAK (J 9426). OTTER (K 11585, UWL). OUTER (J 9608). RASPBERRY (J 6920). ROCKY (Collingson 70, UWL). SAND (J 8555). SOUTH TWIN (Cochrane & Cochrane 9318, WIS). STOCKTON (Middleton s.n., 15 Aug 1979, APIS).

Luzula acuminata Raf., wood-rush. Rare. MADELINE (Grants Point jack pine woods; J 8126).

Luzula multiflora (Retz.) Lej., wood rush. Rare. OAK (steep sandy-clay bank just S of dock; Goessl 7902, MIL; J 9435).

## JUNCAGINACEAE (Arrow-grass Family)

Scheuchzeria palustris L. Occasional, bog mats. LONG (K 8792, UWL). MADELINE (Beals AP-138, WIS). MICHIGAN (Lane 2795, WIS). OUTER (Fraundorf s.n., 13 Sep 1978, UWSP). ROCKY (Dobie 156, WIS). STOCKTON (Lane 2752, WIS).

## LEMNACEAE (Duckweed Family)

Lemna minor L., lesser duckweed. Fairly common, ponds and ditches. BASSWOOD (quarry; J 9342). LONG (K 7572, WIS). MADELINE (J 8771). MAINLAND (K 8626, UWL). MICHIGAN (J 9553). OUTER (J 9597). RASPBERRY (Dobie 71, WIS). ROCKY (J 8913). SAND (J 8306). SOUTH TWIN (J 6843). STOCKTON (J 8428).

Lemna trisulca L., star-duckweed. Rare, ponds. MADELINE (Cheney 5729, WIS). Spirodela polyrhiza (L.) Schleiden, greater duckweed. Rare. LONG (W tip bog pond; J 8603).

### LILIACEAE (Lily Family)

\*Asparagus officinalis L., garden asparagus. Occasional escape from cultivation. BASSWOOD (K 8718, UWL). MADELINE (J 8761). RASPBERRY (sight record:

R. Dobie). SAND (J 9290).

Clintonia borealis (Aiton) Raf., corn-lily, bluebead-lily, or clintonia. Abundant, forests. BASSWOOD (K 8287, UWL). BEAR (J 7079). CAT (J 6149). DEVILS (J 6731). HERMIT (Lane 2127, WIS). IRONWOOD (J 6246). LONG (J 7954). MADELINE (Beals AP-194, WIS). MAINLAND (K 8147). MANITOU (Team 6, UWL). MICHIGAN (J 8054). NORTH TWIN (J 6590). OAK (Jones s.n., WIS). OTTER (J 6374). OUTER (K 10955, UWL). RASPBERRY (Dobie 4, APIS). ROCKY (Team 1, UWL). SAND (Cheney 6192, WIS). SOUTH TWIN (J 8830). STOCKTON (Verch & Riva s.n., 20 Jun 1973, NCAW). YORK (K 11393, UWL).

Erythronium americanum Ker Gawler, yellow trout-lily. Uncommon, rich woods. OTTER (near sand spit; J 6330). OUTER (J 6084). STOCKTON (Trout Point; J

8414). YORK (near campsites; Seebode s.n., 13 May 1992, WIS).

\*Hemerocallis fulva (L.) L., orange day-lily. Uncommonly spreading from cultivation. MICHIGAN (cultivated), OUTER (lighthouse; *J 6598*). RASPBERRY (cultivated). SAND (East Bay; *J 8267*).

\*Lilium lancifolium Thunb., tiger-lily. Uncommon; persisting and spreading from cultivation. MADELINE (J 9379). MAINLAND (K 9082, UWL). OUTER (lighthouse steps; Lowe s.n., 20 Aug 1975, NCAW: persisting as sterile plants, 1992).

Lilium michiganense Farw., Michigan lily. Rare; not seen in present study. MADE-

LINE ("Uncommon;" Goessl 7979, MIL).

Maianthemum canadense Desf., Canada mayflower. Abundant, forests. BASSWOOD (K 8282, UWL). BEAR (J 7059). CAT (J 6145). DEVILS (J 6721). HERMIT (Team 5, UWL). IRONWOOD (J 6248). LONG (Cheney 5314, WIS). MADELINE (Beals AP-199, WIS). MAINLAND (K 8191). MANITOU (K 13633, UWL). MICHIGAN (Team 4, UWL). NORTH TWIN (J 6592). OAK (J 7730). OTTER (J 6398). OUTER (Lane 2170, WIS). RASPBERRY (Dobie 36, APIS). ROCKY (Team 6, UWL). SAND (Cheney 6188, WIS). SOUTH TWIN (Heidel s.n., UWL). STOCKTON (Coffin 364, WIS). YORK (J 8778).

Polygonatum pubescens (Willd.) Pursh, Solomon's-seal. Rich woods. BASSWOOD (occasional; K 8291, UWL). HERMIT (occasional; J 7600). OAK (common; Fassett et al. 20011, WIS). STOCKTON (fairly common; J 8503).

Smilacina racemosa (L.) Desf., false Solomon's-seal. Upland woods. BASSWOOD (common; K 8289, UWL). BEAR (rare; J 7100). HERMIT (fairly common; Team 4, UWL). MADELINE (uncommon; J 8104). MAINLAND (K 8351, UWL). MANITOU (uncommon; J 7222, WIS). MICHIGAN (rare; J 7326). OAK (common; Beals AP-212, WIS). OTTER (rare; J 6360). OUTER (common; Team 6, UWL). RASPBERRY (uncommon; J 6888). ROCKY (uncommon; J 9704). SAND (occasional; Cheney 6225, WIS). STOCKTON (fairly common; Taylor 3621, MIL).

Smilacina stellata (L.) Desf., starry false Solomon's-seal. Rare. SOUTH TWIN (sand spit dunes; J 6484).

Smilacina trifolia (L.) Desf., three-leaved false Solomon's-seal. Fairly common, bogs and old beaver flowages. CAT (N tip interior swamp; J 9269). DEVILS (J 6618). LONG (K 8172, WIS). MADELINE (J 8677). MICHIGAN (J 7369). OUTER (J 9628). SAND (J 8272). STOCKTON (J 8425).

Streptopus amplexifolius (L.) DC., white mandarin. Occasional, ravine bottoms and rich woods. BASSWOOD (K 8480, UWL). BEAR (J 7077). HERMIT (J 7626). IRONWOOD (J 6298). MADELINE (Fuller 4433, MIL). MAINLAND (Iltis & Kawano 20505, WIS). MANITOU (J 7121). MICHIGAN (Team 5, UWL). OAK (fairly common, ravines; Fassett et al. 17184, WIS). OTTER (J 6478). OUTER (fairly common, ravines; Team 1, UWL). RASPBERRY (J 6890). ROCKY (Dobie 176, APIS). SAND (fairly common; Cheney 6169, WIS). SOUTH TWIN (Team 4, UWL). STOCKTON (fairly common, ravines; Verch & Riva s.n., 26 Jun 1973, NCAW).

Streptopus roseus Michaux, rosy twisted-stalk. Occasional to common, woods. BASS-WOOD (K 8288, UWL). BEAR (J 7097). CAT (Team 6, UWL). DEVILS (J 6735). HERMIT (Team 5, UWL). IRONWOOD (J 6200). MADELINE (J 8103). MAIN-LAND (K 8139, UWL). MANITOU (Team 1, UWL). MICHIGAN (J 7319). OAK (J 7728). OTTER (J 6375). OUTER (J 9563). RASPBERRY (K 11233, UWL). ROCKY (J 8932). SAND (sight record: J). SOUTH TWIN (Team 4, UWL). STOCKTON (J 8451). YORK (K 11385, UWL).

Trillium cernuum L., nodding trillium. Occasional, moist woods. BASSWOOD (J 8145). BEAR (J 6993). CAT (J 6110). DEVILS (Lane 2237, WIS). HERMIT (J 7545). IRONWOOD (J 6295). MADELINE (Cheney 5654, WIS). MAINLAND (K 8248, UWL). MANITOU (J 7127). MICHIGAN (fairly common; K 13664, UWL). OAK (Hildebrandt 189, APIS). OTTER (J 6468). OUTER (J 6072). RASPBERRY (Dobie 5, WIS). ROCKY (J 6783). SAND (Cheney 6194, WIS). SOUTH TWIN (J 8838). STOCKTON (K 13738, UWL).

Uvularia sessilifolia L., wild oats or sessile bellwort. Rich upland woods and ravines. BASSWOOD (occasional; J 8157). MADELINE (N ravines; J 8111). MANITOU (rare; J 7232). OAK (fairly common; Hildebrandt 153, APIS). OTTER (occasional; J 6317). STOCKTON (occasional; Falck s.n., 10 Jun 1990, UWSP).

## NAJADACEAE (Naiad Family)

Najas flexilis (Willd.) Rostk. & Schmidt, naiad. Uncommon, ponds. LONG (Siegwarth s.n., 9 Sep 1989, ISC). MADELINE (sight record: W. Tans & R. H. Read, 1971).

### ORCHIDACEAE (Orchid Family)

Arethusa bulbosa L., dragonmouth. Occasional, bog mats. MADELINE (Big Bay and Amnicon Bay bogs; Grether 7217, WIS). MAINLAND (Sand River bog; Cheney 6378, WIS. Little Sand Bay slough bog; J 8511). OUTER (J 6017). STOCKTON (Julian Bay, Lane 2759, WIS. Quarry Bay; J 9168).

Calopogon tuberosus (L.) Britton, Stearns, & Pogg., grass-pink. Occasional, bog mats and boggy meadows. MADELINE (Beals AP-121, WIS). MICHIGAN (J 7457). OUTER (sight record: J, sand spit bog). ROCKY (J 7465). STOCKTON (Goessl 7033 WIS)

Calypso bulbosa (L.) Oakes, calypso orchid. Rare, old growth cedar swamps. MAIN-

LAND (shores, Sand Bay to Squaw Bay [perhaps from the Sand Point white cedar forest]; Cheney 6422, WIS: not relocated in present study).

Coeloglossum viride (L.) Hartman, long-bracted orchid. Rare, wooded ravines. MAIN-LAND (occasional, Little Sand Bay; K 8588, WIS). MADELINE (Fuller 4449, MIL).

- Corallorhiza maculata (Raf.) Raf., spotted coral-root. Fairly common, woods. BASS-WOOD (Lane 2409, WIS). BEAR (J 7005). CAT (J 9252). DEVILS (S. Oswald, photograph, WIS). HERMIT (Cheney 5890, WIS). IRONWOOD (J 9203). MADE-LINE (Goessl 7938, MIL). MAINLAND (K 8377, UWL). MANITOU (J 7204). MICHIGAN (J 7289). OAK (Beals AP-222, WIS). OTTER (Lane 2197, WIS). OUTER (Tans 41, WIS). RASPBERRY (Dobie 25, WIS). ROCKY (J 6761). SAND (Massopeist s.n., Jul 1980, UWSP). SOUTH TWIN (Cottam & Vogl 595, WIS). STOCKTON (Beals AP-45, WIS). YORK (sight record: R. Dobie).
- Corallorhiza striata Lindley, striped coral-root. Occasional, woods. CAT (J 6119). HERMIT (J 7543). MADELINE (Goessl 7939, MIL). MAINLAND (Cheney 6441, WIS). MICHIGAN (J 7327). OAK (Beals AP-57, WIS). OTTER (J 6322). OUTER (Fraundorf s.n., 25 Jul 1978). RASPBERRY (Middleton s.n., 11 Jun 1980, APIS). STOCKTON (Verch & Riva s.n., 20 Jun 1973, NCAW).
- Corallorhiza trifida Châtel., early coral-root. Occasional, woods, often in second growth. BEAR (J 7089). CAT (J 9281). DEVILS (J 6712). HERMIT (Cheney 5889, WIS). IRONWOOD (J 6196). LONG (J 8376). MADELINE (Beals AP-188, WIS). MAINLAND (K 8247). MICHIGAN (J 7327). OAK (Curtis 38-34, WIS). OTTER (J 8871). OUTER (Fraundorf s.n., 7 Jul 1978, UWSP). RASPBERRY (J 6918). ROCKY (J 6806). SAND (Cheney 6222, MIL). SOUTH TWIN (J 6444). STOCKTON (Beals AP-35, WIS).
- Cypripedium acaule Aiton, pink or stemless lady's-slipper or moccasin-flower. Occasional, sand spit pine woods, bogs, and acid woods adjacent to bogs. BASSWOOD (K 8439, WIS). BEAR (summit bog; J 7104). CAT (N tip; J 6185). DEVILS (common, N tip; Cochrane & Cochrane 9188, WIS). LONG (K 7368, WIS). MADELINE (Beals AP-187, WIS). MAINLAND (K 8339, UWL). MANITOU (J 7236). MICHIGAN (J 7314). OTTER (J 6479). OUTER (Tans 22, WIS). ROCKY (J 6758). SAND (Massopeist s.n., Jul 1980, UWSP). SOUTH TWIN (J 6449). STOCKTON (K 6977). YORK (J 8810).
- Goodyera oblongifolia Raf., green-leaved rattlesnake-plantain. Occasional, upland woods, often near the lake on old beaches. BASSWOOD (Cheney 5781, WIS). BEAR (J 6952). CAT (J 6191). HERMIT (J 7551). IRONWOOD (J 6225). MADELINE (Tans 24, WIS). MAINLAND (K 8860, UWL). MICHIGAN (J 7975). OAK (Jones s.n., WIS). OTTER (J 6333). OUTER (Fraundorf s.n., 6 Aug 1978, UWSP). ROCKY (J 6763). STOCKTON (Beals AP-41, WIS).
- Goodyera repens (L.) R. Br., dwarf rattlesnake-plantain. Uncommon, woods. BEAR (J 7550). DEVILS (J 6741). MAINLAND (Sand Bay; Cheney 6407, WIS). MICHIGAN (J 7343). OAK (Toole s.n., WIS). ROCKY (Dobie 178, WIS).
- Goodyera tesselata Lodd., checkered rattlesnake-plantain. Occasional, woods. BASS-WOOD (Cheney 5788, WIS). BEAR (J 7551). CAT (J 6191). DEVILS (Clements & Collingson D-24, UWL). HERMIT (J 7550). MADELINE (Goessl 7940, MIL). MANITOU (J 7175). MICHIGAN (J 7360). OAK (Hildebrandt 168, APIS). OTTER (J 9774). OUTER (Tans 24, WIS). ROCKY (Clements R-15, UWL). SAND (Cheney 6221, WIS). STOCKTON (Clements 336, APIS).
- Liparis loeselii (L.) Rich., Loesel's or bog twayblade. Rare. LONG (wet, sandy lake flats at closed-in breach of sand spit; Cheney 5362, J 7970, WIS).
- Listera convallarioides (Sw.) Torrey, broad-lipped twayblade. Rich, mesic ravines. MAINLAND (locally common, Little Sand Bay area [Sec. 32–22 of T52N, R4W and Sec. 6 of T52N, R5W]; K 8575, WIS). OAK (scattered populations in most ravines; Goessl 7935, WIS).
- Listera cordata (L.) R. Br., heartleaf twayblade. Uncommon, swamps. BEAR (summit bog cedars; K 11115, UWL). DEVILS (central bog; Cochrane & Cochrane 9180, WIS). STOCKTON (locally common, swampy mixed woods in center of island; also in alder thicket; J 8480).

- Malaxis unifolia Michaux, green adder's-mouth. Uncommon, moist woods, often near edges. BASSWOOD (K 8683, UWL). LONG (K 10781, UWL). MADELINE (Cheney 5644, WIS). MAINLAND (K 8869, UWL). MANITOU (S tip; J 7246). OAK (Curtis 38–41, WIS).
- Platanthera clavellata (Michaux) Luer, club-spur orchid. Fairly common, wet sandy swales, clearings, trailsides, and bogs. BASSWOOD (quarry; J 9343). DEVILS (J 6676). LONG (Cheney 5336, WIS). MADELINE (Cooper s.n., WIS). MICHIGAN (J 7384). OUTER (J 7495). RASPBERRY (J 6925). SOUTH TWIN (airstrip; Heidel s.n., UWL). STOCKTON (Escoll 263, WIS).
- Platanthera dilatata (Pursh) Beck, tall white orchid. Rare; not noted in present study. LONG (Cheney 5359, WIS).
- Platanthera hyperborea (L.) Lindley, tall northern green orchid. Occasional to fairly common, bog and swamp margins, seeping clay bluffs, ravine seeps, and wet trails. BASSWOOD (Cheney 5787, WIS). CAT (J 6102). DEVILS (J 6693). LONG (J 8384). MAINLAND (K 8379, UWL). MANITOU (J 7247). MICHIGAN (J 7346). OAK (Curtis 38-43, WIS). OTTER (K 12802, UWL). OUTER (J 7501). RASPBERRY (Middleton s.n., 11 Jun 1980, UWL). ROCKY (Dobie 138, WIS). SAND (Massopeist s.n., Jul 1980, UWSP). STOCKTON (Lane 2249, WIS). YORK (J 8812).
- Platanthera lacera (Michaux) G. Don, ragged fringed orchid. Occasional, moist woods and old clearings. BASSWOOD (Rudd Farm; J 9355). HERMIT (Bruder Farm; J 7620). MADELINE (Cheney 5738, WIS). OUTER (several places such as airstrip; J 9609). SAND (Massopeist s.n., Jul 1980, UWSP). STOCKTON (K 10811, UWL).
- Platanthera ×media (Rydb.) Luer (P. dilatata×P. hyperborea). Rare. OAK (Curtis 38-40, WIS).
- *Platanthera obtusata* (Pursh) Lindley, blunt-leaved orchid. Rare, conifer swamps. MAINLAND (Little Sand Bay; *K 8574*, WIS).
- Platanthera orbiculata (Pursh) Lindley, round-leaved orchid. Uncommon except on OAK, where fairly common; deciduous or mixed woods, often along trails, also rich ravines. BASSWOOD (Cheney 5777, WIS). BEAR (J 9724). HERMIT (J 9500). MADELINE (Cheney 5658, MIL). MAINLAND (occasional in ravines in Little Sand Bay area; K 8572, UWL). MICHIGAN (sight record: J). OAK (Curtis 38–45, WIS). OTTER (sight record: J). ROCKY (sight record: R. Dobie). SAND (SE<sup>1</sup>/4 of NW<sup>1</sup>/4, Sec. 24; J 8549). SOUTH TWIN (sight record: B. Middleton). STOCKTON (Julian Bay pine woods; K 10786, UWL).
- Platanthera psycodes (L.) Lindley, purple fringed orchid. Rare, wet swales in woods and woods edges. MICHIGAN (lighthouse; Team 1, UWL). OUTER (Fraundorf s.n., 13 Jul 1978, UWSP).
- Pogonia ophioglossoides (L.) Juss., rose pogonia. Occasional, bog mats and wet sandy swales. MADELINE (Big Bay and Amnicon Bay bogs; Beals AP-120, WIS). MAIN-LAND (K 8619, UWL). MICHIGAN (J 7364). OUTER (Fraundorf s.n., UWSP). RASPBERRY (J 6935). STOCKTON (Lane 2420, WIS).
- Spiranthes cernua (L.) Rich., nodding ladies'-tresses. Uncommon, wet sandy swales and meadows. LONG (Kimber s.n., 9 Sep 1989, ISC). OUTER (Fraundorf s.n., 13 Sep 1978, UWSP).
- Spiranthes lacera (Raf.) Raf., northern slender ladies'-tresses. Uncommon, wet sandy swales and meadows. DEVILS (Taylor 3704, MIL). LONG (K 8744, UWL). MADE-LINE (Cheney 5645, WIS). MAINLAND (K 8868, UWL). OUTER (Sand Point; Tans 40, WIS).
- Spiranthes romanzoffiana Cham., hooded ladies'-tresses. Occasional, wet sandy swales and meadows. DEVILS (Taylor 3692, MIL). LONG (J 7923). MADELINE (Cheney 5647, WIS). OUTER (Sand Point; Tans 25, WIS). SAND (Beals AP-175, WIS). SOUTH TWIN (airstrip; Heidel s.n., UWL).

#### PONTEDERIACEAE (Pickerelweed Family)

Heteranthera dubia (Jacq.) MacMillan, water star-grass. LONG (sandy bottom of open pool N of light; Kimber s.n., 9 Sep 1989, ISC).

## POTAMOGETONACEAE (Pondweed Family)

Potamogeton amplifolius Tuckerman. Uncommon, lagoons. MADELINE (Cheney 5589, WIS). STOCKTON (Verch & Riva s.n., 25 Jul 1973, NCAW).

Potamogeton berchtoldii Fieber. Occasional, lagoons and ponds. MADELINE (Goessl 5591, MIL). MICHIGAN (beaver pond at E tip; K 13902, UWL).

Potamogeton epihydrus Raf. Uncommon, lagoons. MADELINE (Cheney 5597, WIS). STOCKTON (Quarry Bay slough; J 9848).

Potamogeton gramineus L. Occasional, lagoons and in shallow lake water. LONG (K 10513, UWL). OUTER (central beaver flowage; J 9630). SAND (West Bay creek; J 8542). SOUTH TWIN (W shore; Radomski s.n., 30 Aug 1984, UWSP). STOCKTON (Presque Isle Bay; Radomski s.n., 30 Sep 1984, UWSP).

Potamogeton illinoensis Morong. Rare, ponds. MICHIGAN (pool between bog and beach, W tip; K 11736, UWL).

Potamogeton natans L. Occasional, lagoons and in lake. BASSWOOD (W dock, J 9330). MADELINE (new marina; J 9808). OUTER (sand spit lagoon, sight record: W. Tans). STOCKTON (Julian Bay; J 8472).

Potamogeton oakesianus Robbins. Rare, lagoon. OUTER (sand spit lagoon; K 10914, UWL).

Potamogeton pectinatus L. Rare, mud flat pool. LONG (Levings s.n., 10 Sep 1989, ISC).

Potamogeton perfoliatus L. Rare, dune pool. LONG (Levings s.n., 9 Sep 1989, ISC).
Potamogeton richardsonii (A. Bennett) Rydb. Occasional, lagoons and in open lake.
BASSWOOD (Cheney 5779, WIS). LONG (Hatch s.n., 8 Sep 1989, ISC). MADE-LINE (Grants Point slough; J 8740. new marina; J 9814). OTTER (lake 2.5 m deep off dock; Bowers 11685, UWSP).

Potamogeton robbinsii Oakes. Uncommon, lagoons. MADELINE (Cheney 5587, WIS).

Potamogeton spirillus Tuckerman. Rare, ponds. MADELINE (new marina; *J 9813*). Potamogeton zosteriformis Fern. Uncommon, bog ponds. LONG (*K 7570*, UWL). MADELINE (sight record: W. Tans & R. H. Read, 1971).

Potamogeton sp. SAND (West Bay creek; J 8542).

### SPARGANIACEAE (Bur-reed Family)

Sparganium angustifolium Michaux. Occasional, lagoons and ponds. MADELINE (Cheney 5659, WIS). MAINLAND (K 8601, UWL). MICHIGAN (old beaver pond, E tip; K 13897, UWL). OUTER (sand spit lagoon; K 10910, WIS).

Sparganium chlorocarpum Rydb. Fairly common, ponds and ditches. DEVILS (near Stip; J 6678). HERMIT (J 9472). IRONWOOD (J 9207). LONG (K 8804, UWL).
MADELINE (Goessl 8040, MIL). OUTER (J 9589). SAND (West Bay creek; J 9308).
RASPBERRY (bog pool, rare; Middleton s.n., 2 Aug 1978, APIS). ROCKY (S slough; J 8912). SOUTH TWIN (ruts in airstrip road; Heidel s.n., 24 Aug 1977, UWL). STOCKTON (Taylor 3650, MIL).

Sparganium eurycarpum Engelm. Uncommon, lagoons. LONG (Nejadsattari s.n., 17 Sep 1988, ISC). MADELINE (Goessl 7942, MIL). OUTER (sand spit lagoon; Lane 2266, WIS). STOCKTON (Julian Bay; J 9865).

## TYPHACEAE (Cat-tail Family)

Typha angustifolia L., narrow-leaved cat-tail. Rare, marshes. MICHIGAN (J 7446). Typha ×glauca Godron (T. angustifolia × T. latifolia). Rare, marsh. LONG (K 8803, UWL).

Typha latifolia L., common cat-tail. Common, marshes, bog edges, and ditches. BASS-WOOD (J 8336). DEVILS (along road near S tip; J 6625). MADELINE (J 8772). MAINLAND (K 9078). MICHIGAN (Lane 2552, WIS). OUTER (J 7509). RASP-BERRY (Dobie 117, WIS). ROCKY (Clements R-104, UWL). SAND (J 8506). SOUTH TWIN (J 6842). STOCKTON (J 8506). YORK (K 11469, UWL).

## XYRIDACEAE (Yellow-eyed Grass Family)

Xyris montana H. Ries, yellow-eyed grass. Occasional, bog mats. MADELINE (Big Bay bog; Tans 917, MIL). MICHIGAN (J 9537). OUTER (sight record: E. Epstein, 14 Jul 1988). STOCKTON (Julian Bay bog; Taylor 3652, MIL).

### **DICOTYLEDONS**

### ACERACEAE (Maple Family)

Acer negundo L., box-elder. Seedlings occasionally present on shores, especially near docks. BASSWOOD (J 8179). IRONWOOD (J 6260). LONG (J 7937). MADELINE (J 9417). MANITOU (J 7154). OUTER (sand spit; J 7508). SAND (trees, Shaw Farm; J 9284). STOCKTON (J 7898). YORK (J 8824).

\*Acer platanoides L., Norway maple. LONG (fairly common small tree, bayshore; J

8360).

Acer rubrum L., red maple. Common, woods. BASSWOOD (K 8299, UWL). BEAR (J 6957). CAT (K 12036, UWL). DEVILS (J 6727). HERMIT (J 7608). IRONWOOD (J 6279). LONG (K 7502, WIS). MADELINE (J 8071). MANITOU (J 7256). MICHIGAN (K 11763, WIS). NORTH TWIN (J 9680). OAK (J 7727). OTTER (J 6399). OUTER (K 13470, UWL). RASPBERRY (J 6930). ROCKY (Lane 2773, WIS). SAND (Middleton s.n., 27 May 1980, APIS). SOUTH TWIN (Heidel s.n., UWL). STOCKTON (Verch & Riva s.n., 28 Jun 1973, NCAW). YORK (K 11400, UWL).

Acer saccharinum L., silver maple. LONG (occasional, wet dune edges near sand cut; J

7944).

Acer saccharum Marshall, sugar maple. Common, upland woods. BASSWOOD (J 8133). BEAR (J 7062). CAT (J 6161). DEVILS (J 6751). EAGLE (sight record: J). GULL (two 10–12" dbh trees recorded in original land survey, 1852–1857; not present in 1991). HERMIT (Lane 2779, WIS). IRONWOOD (J 6280). LONG (J 8389). MADELINE (J 8077). MANITOU (J 7254). MICHIGAN (J 7421). NORTH TWIN (J 6541). OAK (J 7733). OTTER (J 6395). OUTER (J 7510). RASPBERRY (J 8036). ROCKY (Lane 2774, WIS). SAND (J 8211). SOUTH TWIN (Heidel s.n., UWL). STOCKTON (J 8431). YORK (J 8818).

Acer spicatum Lam., mountain maple. Common in forest understory. BASSWOOD (K 8297, UWL). BEAR (J 7073). CAT (J 6169). DEVILS (Taylor 3675, WIS). EAGLE (J 7858). GULL (uncommon, J 7879). HERMIT (J 7629). IRONWOOD (J 6286). MADELINE (Lapham s.n., Sep 1858, WIS). MAINLAND (K 8310, UWL). MANITOU (Team 3, UWL). MICHIGAN (J 7459). NORTH TWIN (J 6578). OAK (Hildebrandt 283, APIS). OTTER (J 6436). OUTER (K 13432, UWL). RASPBERRY (K 11219, UWL). ROCKY (J 8854). SAND (Cheney 6180, WIS). SOUTH TWIN (Beals AP-207, WIS). STOCKTON (Taylor 3602, MIL). YORK (K 11490, UWL).

## AIZOACEAE (Carpetweed Family)

\*Mollugo verticillata L., carpetweed. MAINLAND (weed on sandy roadside, Little Sand Bay; J 8575).

## AMARANTHACEAE (Amaranth Family)

Amaranthus albus L., tumbleweed. MAINLAND (Sand Bay; Cheney 6054, WIS).
\*Amaranthus retroflexus L., pigweed. GULL (sight record: W. Tans, 1977; not noted in 1991). LONG (sight record: J, 1991). RASPBERRY (garden weed; J 9927).

### ANACARDIACEAE (Cashew Family)

Rhus radicans L., poison-ivy. Uncommon (except on Long), sand spits, clearings, and woods. CAT (NW clearing; *J 9267*). LONG (abundant, dunes; *K 8992*, UWL). MADELINE (Pointe de Froide, La Pointe town beach, Amnicon Bay beach, and Grants Point area; *J 8739*). MICHIGAN (rare, sand spit at old railhead; *Middleton s.n.*, 12 Jul 1979, APIS: not noted in present study). STOCKTON (rare, woods, SE<sup>1</sup>/4 of NW<sup>1</sup>/4, Sec. 5; *J 9142*).

Rhus typhina L., staghorn sumac. Occasional, bluff tops and edges of old clearings.

BASSWOOD (Rudd Farm; Middleton s.n., APIS). LONG (sand cut; J 7931).

MADELINE (Goessl 7985, MIL). MAINLAND (K 8964, UWL). MANITOU (J

9074). OAK (SE of dock; Hildebrandt 214, APIS). RASPBERRY (lighthouse; Dobie 78, WIS).

### APOCYNACEAE (Dogbane Family)

Apocynum androsaemifolium L., dogbane. Fairly common, sand spit dunes, clearings, and young woods. BEAR (J 7049). CAT (J 6177). HERMIT (J 7610). LONG (J 8359). MAINLAND (K 8552, UWL). MANITOU (J 7255). MICHIGAN (J 7381). OAK (Hildebrandt 192, APIS). OTTER (J 6419). OUTER (Jackson & Sheldon 198, WIS). RASPBERRY (J 6892). SAND (Massopeist s.n., Jul 1980, UWSP). SOUTH TWIN (Heidel s.n., UWL). STOCKTON (Falck s.n., 25 Jul 1990, UWSP).

Apocynum cannabinum L., Indian hemp. Fairly common, sand spits and clearings. BASSWOOD (K 8712, UWL). HERMIT (Team 6, 16 Jul 1975, UWL). MAINLAND (K 8965, UWL). OAK (K 11782, UWL). OTTER (Bowers 11727-a, UWSP). RASPBERRY (K 14037, UWL).

\*Vinca minor L., common periwinkle. Cultivated and spreading near lighthouses and cemeteries. MADELINE (J 8120). MICHIGAN (J 7410). SAND (J 8193).

### AQUIFOLIACEAE (Holly Family)

Ilex verticillata (L.) A. Gray, winterberry holly. Occasional, bog margins and alder thickets. CAT (N point interior swamp; J 9275). MADELINE (J 8698). MICHIGAN (J 7388). OUTER (K 10922, UWL). SAND (J 8278). STOCKTON (Lane 2435, WIS).

Nemopanthus mucronatus (L.) Loes., mountain-holly. Occasional, bog margins and alder thickets. LONG (J 8373). MADELINE (Cheney 5678, WIS). MICHIGAN (J 7288). OUTER (Tans s.n., 23 Aug 1971, WIS). STOCKTON (fairly common, swampy woods; J 8426).

### ARALIACEAE (Ginseng Family)

Aralia hispida Vent., bristly sarsaparilla. Fairly common, beaches and sand spits. BEAR (J 9122). DEVILS (S tip; J 6670). IRONWOOD (J 6203). LONG (J 8355). MADELINE (Toole s.n., 7 Jul 1910, WIS). MAINLAND (K 8971, UWL). MICHIGAN (J 7269). NORTH TWIN (J 6543). OAK (Goessl 7911, MIL). OTTER (K 11568, UWL). OUTER (Fraundorf 20, UWSP). ROCKY (J 6800). SAND (J 8284). SOUTH TWIN (Cochrane & Cochrane 9319, WIS). STOCKTON (Taylor 3617, MIL). YORK (K 11486, UWL).

Aralia nudicaulis L., wild sarsaparilla (Fig. 26). Abundant, woods. BASSWOOD (K 8258, UWL). BEAR (J 7083). CAT (J 6173). DEVILS (Clements & Collingson D-80, UWL). EAGLE (J 7803). HERMIT (J 7622). IRONWOOD (J 6202). LONG (J 7956). MADELINE (Grether 7201, WIS). MAINLAND (K 8141, UWL). MANITOU (J 9044). MICHIGAN (J 7424). NORTH TWIN (J 6582). OAK (Goessl 7887, MIL). OTTER (J 6364). OUTER (Lane 2514, WIS). RASPBERRY (Dobie s.n., APIS). ROCKY (Clements R-12, UWL). SAND (Cheney 6179, WIS). SOUTH TWIN (J 8852). STOCKTON (Houser s.n., 21 Sep 1990, UWSP). YORK (J 8790).

Aralia racemosa L., spikenard. Occasional, rich woods, ravines, and shaded cliffs. BASSWOOD (K 8674, UWL). BEAR (sight record: J). HERMIT (Team 6, UWL). MAINLAND (K 8893, UWL). MANITOU (J 7225). MICHIGAN (J 7323). OAK (Goessl 7888, MIL). OTTER (J 6359). OUTER (K 10959, UWL). RASPBERRY (J 6891). ROCKY (K 11821, UWL). SOUTH TWIN (Heidel s.n., UWL). STOCKTON (K 10819, UWL).

Panax trifolius L., dwarf ginseng. Fairly common, rich upland woods. BASSWOOD (J 8154). BEAR (J 7096). CAT (J 6137). HERMIT (J 8061). IRONWOOD (J 6224). MADELINE (J 8075). MANITOU (J 8048). OAK (Beals AP-82, WIS). OTTER (J 8879). OUTER (J 6014). RASPBERRY (ravine; K 11261, UWL). ROCKY (J 8930). SAND (J 6043). SOUTH TWIN (J 6451). STOCKTON (J 8453).

#### ASCLEPIADACEAE (Milkweed Family)

Asclepias incarnata L., swamp milkweed. Uncommon, wetlands. LONG (sand cut; J 7914). ROCKY (sight record: R. Dobie). STOCKTON (Goessl 7934, MIL).

Asclepias syriaca L., common milkweed. Fairly common, sand spit dunes, less common in clearings. BASSWOOD (Rudd Farm; Middleton s.n., 30 Jul 1980, APIS). CAT (J



FIGURE 26. Distribution of wild sarsaparilla (Aralia nudicaulis). This pattern is typical of many common upland forest herbs, which are most abundant on the largest islands and smaller near-shore islands on the lee side of the Bayfield Peninsula. Note complementarity with the distribution of Canada yew as a dominant understory shrub (Fig. 4).

6172). HERMIT (*J* 7636). IRONWOOD (*J* 6526). LONG (*K* 8774, WIS). MADE-LINE (*J* 8734). MANITOU (*J* 7208). MICHIGAN (*K* 11759, UWL). OAK (*J* 7786). OTTER (*J* 6328). OUTER (*J* 7504). ROCKY (*J* 9692). SAND (*Clements R-*86, UWL). SOUTH TWIN (*J* 6485). STOCKTON (*Lane 2520*, WIS).

## BALSAMINACEAE (Touch-me-not Family)

Impatiens capensis Meerb., spotted touch-me-not or orange jewelweed. Common, wetland edges. BASSWOOD (K 8713, WIS). BEAR (J 7068). CAT (rare; J 9263). DEVILS (J 6639). EAGLE (J 7809). GULL (rare; J 7871). HERMIT (J 7536). IRONWOOD (rare; J 9208). LONG (Cheney 5379, WIS). MADELINE (J 8692). MAINLAND (K 8909, UWL). MANITOU (Team 1, UWL). MICHIGAN (K 13884, UWL). NORTH TWIN (J 6538). OAK (J 7750). OTTER (J 6416). OUTER (Team 6, UWL). RASPBERRY (J 8956). ROCKY (K 11856, UWL). SAND (J 8246). SOUTH TWIN (Heidel s.n., UWL). STOCKTON (K 9997, UWL). YORK (K 11487, UWL). Impatiens pallida Nutt., pale touch-me-not. Rare. MAINLAND (alder thicket, Little Sand Bay; K 8946, UWL). OTTER (wet open depression; Bowers 11756, UWSP).

#### BERBERIDACEAE (Barberry Family)

\*Berberis thunbergii DC., Japanese barberry. Uncommon, persisting and spreading from cultivation. MADELINE (invading woods near La Pointe and Grants Point; *J* 8127). SAND (woods along old N-S road; *J* 6042).

## BETULACEAE (Birch Family)

Alnus incana (L.) Moench subsp. rugosa (Duroi) Clausen, speckled or tag alder. Common, wetland edges and coasts. BASSWOOD (J 8178). BEAR (J 8008). CAT (J 6131). DEVILS (J 6661). EAGLE (J 7837). HERMIT (J 7544). IRONWOOD (Collingson s.n., UWL). LONG (J 7377). MADELINE (Lapham s.n., Sep 1858, WIS). MANITOU (J 7227). MICHIGAN (Lane 2804, NCAW). OAK (J 7732). OTTER (J 8868). OUTER (K 10967, UWL). RASPBERRY (J 8034). ROCKY (J 8886). SAND (Middleton s.n., 27 May 1980, APIS). SOUTH TWIN (J 6490). STOCKTON (Escoll 265, MIL). YORK (K 11397, UWL).

Alnus viridis (Villars) Lam. subsp. crispa (Aiton) Turrill, green alder. Common, coasts; occasional inland. BASSWOOD (Team 5, UWL). BEAR (J 6961). CAT (K 12094, UWL). DEVILS (J 6722). EAGLE (J 7842). HERMIT (J 7596). IRONWOOD (J 6220), MADELINE (Cheney 5667, WIS), MAINLAND (K 8134, UWL), MANITOU (Team 3, UWL). MICHIGAN (J 7322). OAK (J 7770). OTTER (J 6311). OUTER (Fraundorf s.n., 11 Sep 1978, UWSP). RASPBERRY (J 6919). ROCKY (Cochrane & Cochrane 9240, WIS). SAND (J 6037). SOUTH TWIN (J 8828). STOCKTON (K 8829). YORK (J 7696).

Betula alleghaniensis Britton, yellow birch. Common, woods. BASSWOOD (Lowe s.n., 30 Jun 1975, NCAW). BEAR (J 7025). CAT (K 12102, UWL). DEVILS (J 6620). EAGLE (J 7831). GULL (K 13932, UWL; not relocated in 1991). HERMIT (J 7526). IRONWOOD (J 6273). MADELINE (Escoll 706, MIL). MANITOU (J 8049). MICHIGAN (J 7422). NORTH TWIN (K 13563, UWL). OAK (Escoll 44, MIL). OTTER (J 6383). OUTER (J 9593). RASPBERRY (J 8023). ROCKY (J 8931). SAND (Cheney 6189, WIS). SOUTH TWIN (Heidel s.n., UWL). STOCKTON (Falck s.n., 21 Aug 1990, UWSP). YORK (K 11398, UWL).

Betula glandulifera (Regel) Butler, bog birch. Rare. LONG (bayshore bog swales in E

part; J 8358).

Betula papyrifera Marshall, paper or white birch. Abundant, woods. BASSWOOD (Lowe s.n., 30 Jul 1975, NCAW). BEAR (J 7026). CAT (J 6158). DEVILS (J 8979). EAGLE (sight record: J). HERMIT (J 7527). IRONWOOD (J 6278). LONG (K 8170, UWL). MADELINE (Escoll 703, MIL). MANITOU (J 7244). MICHIGAN (J 7426). NORTH TWIN (J 6573). OAK (J 7731). OTTER (J 6384). OUTER (Team 5, UWL). RASPBERRY (Middleton s.n., 20 Jun 1982, APIS). ROCKY (Middleton s.n., 2 Jul 1980, APIS). SAND (J 8261). SOUTH TWIN (Cochrane & Cochrane 9241, WIS). STOCKTON (Lane 2337, NCAW). YORK (K 11381, UWL).

Corylus americana Walter, American hazelnut. OAK (common, woods in W part; J

9425). OUTER (sight record: R. B. Brander).

Corylus cornuta Marshall, beaked hazelnut. Abundant, woods. BASSWOOD (Middleton s.n., 11 Aug 1980, APIS). BEAR (J 7086). CAT (J 6123). DEVILS (J 8993). EAGLE (J 7787). HERMIT (J 8064). IRONWOOD (J 6265). MADELINE (J 8087). MAINLAND (K 8531, UWL). MANITOU (J 7136). MICHIGAN (J 9514). NORTH TWIN (J 6587). OAK (Goessl 7908, MIL). OTTER (J 6391). OUTER (J 7511). RASPBERRY (J 8033). ROCKY (J 8892). SAND (J 8221). SOUTH TWIN (Team 4, UWL). STOCKTON (K 13741, UWL). YORK (J 8776).

Ostrya virginiana (Miller) K. Koch, hop-hornbeam. Occasional to fairly common, mesic woods. BASSWOOD (J 8177). BEAR (J 7101). CAT (J 6124). HERMIT (J 7650). IRONWOOD (J 6206). MADELINE (Goessl 8035, MIL). MAINLAND (K 8242, UWL). MANITOU (J 7171). MICHIGAN (J 7460). OAK (Goessl 7909, MIL). OTTER (J 6318). OUTER (Team 1, UWL). ROCKY (Dobie 140, WIS). SAND (sight record: R. Anderson). SOUTH TWIN (J 8940). STOCKTON (Verch & Riva s.n., 9 Aug 1973, NCAW).

#### BORAGINACEAE (Borage Family)

\*Myosotis arvensis (L.) Hill. Uncommon weed. DEVILS (septic tank mound; J 6685). MADELINE (Knowlton s.n., 17 Jun 1929, MIL. Chebomnicon Bay; J 8727). SOUTH TWIN (J 8829).

<sup>\*</sup>Myosotis scorpioides L., true forget-me-not. Locally common weed in woods and

- ravines near buildings. MADELINE (Sec. 29; J 9360). MICHIGAN (lighthouse; J 7384). SAND (common, South Road; J 6039).
- \*Myosotis sylvatica Hoffm., garden forget-me-not. Rare weed. MADELINE (Tans 914, MIL). MAINLAND (K 8142, UWL).
- \*Symphytum officinale L., common comfrey. RASPBERRY (spreading down clay bluffs in front of lighthouse; *J* 8965).

# CALLITRICHACEAE (Water Starwort Family)

Callitriche verna L., water starwort. Occasional, beaver ponds and creek outlets. BASS-WOOD (W dock; J 9329). LONG (J 8602). MADELINE (J 9398). OUTER (Fraundorf s.n., 6 Aug 1978, UWSP). STOCKTON (J 8479).

## CAMPANULACEAE (Bluebell Family)

- Campanula aparinoides Pursh, marsh bellflower. Occasional, wet thickets and swamp margins. LONG (K 9003, UWL). MADELINE (sight record: W. Tans & R. H. Read). MAINLAND (Sand River bog; J 9872). OTTER (sand spit; J 9770). STOCKTON (Escoll 273, MIL).
- \*Campanula rapunculoides L., creeping bellflower. Occasionally persisting and spreading near buildings. DEVILS (S tip campsite; J 9964). MICHIGAN (J 7398). ROCKY (Nies fish camp; J 6777). SAND (Shaw Farm; J 9292).
- Campanula rotundifolia L., harebell. Locally common, wave-splashed sandstone ledges; rare in clearings. CAT (occasional, E coast; Team 1, 6 Aug 1975, UWL).
  MANITOU (NE tip; J 9045). OUTER (common, E coast; J 7473). SAND (common, Lighthouse Point; Massopeist s.n., Jul 1980, UWSP). STOCKTON (W coast clearing; J 9150). YORK (common, N coast rocks; J 7687).
- Lobelia inflata L., Indian-tobacco. Uncommon, wet, sandy areas. LONG (rare, sand cut; J 8629). MADELINE (Cheney 5690, MIL). OTTER (sight record: W. Tans, N landing).
- Lobelia kalmii L., brook lobelia. Uncommon, moist sandstone ledges and cliffs. DEV-ILS (N and W coasts; Taylor 3697, MIL). OAK (SE tip; Lane 2870, WIS: still present in 1992). MADELINE (sight record: W. Tans, Big Bay Point, 10 Aug 1973). OUTER (uncommon, E coast; J 7476). STOCKTON (SE Presque Isle Point; J 7900).

## CAPRIFOLIACEAE (Honeysuckle Family)

- Diervilla lonicera Miller, bush-honeysuckle. Common, upland woods. BASSWOOD (Team 6, WIS). BEAR (J 7115). CAT (J 6156). DEVILS (J 6707). HERMIT (J 7555). IRONWOOD (J 6235). LONG (J 8387). MADELINE (Cheney 5656, WIS). MAINLAND (K 8528, UWL). MANITOU (J 7133). MICHIGAN (J 7286). NORTH TWIN (J 6580). OAK (Beals AP-90, WIS). OTTER (J 6400). OUTER (Team 6, WIS). RASPBERRY (sight record: J). ROCKY (Team 6, UWL). SAND (J 8188). SOUTH TWIN (Team 4, UWL). STOCKTON (Beals AP-29, WIS). YORK (K 11406, UWL).
- Linnaea borealis L., twinflower. Fairly common, coniferous woods and bog margins. BEAR (J 7005). CAT (J 6141). DEVILS (J 6733). HERMIT (J 7535). LONG (J 7951). MADELINE (Cheney 5675, WIS). MAINLAND (K 8382, UWL). MICHIGAN (J 7311). NORTH TWIN (J 6559). OAK (Jones s.n., WIS). OUTER (Lowe s.n., 11 Aug 1975, NCAW). ROCKY (J 6790). SAND (Cheney 6162, WIS). STOCKTON (K 6979). YORK (J 7671).
- \*Lonicera ×bella Zabel (L. morrowii × L. tatarica). Rare. MADELINE (Grether 7226, WIS).
- Lonicera canadensis Marshall, fly honeysuckle. Upland woods; most common on the large islands, occasional or absent on the smaller ones. BASSWOOD (common; *K 8295*, UWL). BEAR (*J 6992*). HERMIT (*J 7546*). MADELINE (Cheney 5655, WIS). MAINLAND (*K 8580*, UWL). MANITOU (*J 7125*). MICHIGAN (*J 7425*). OAK (common; Goessl 7924, MIL). OTTER (*J 6467*). OUTER (*J 9562*). ROCKY (sight record: R. Dobie). SAND (*J 8212*). SOUTH TWIN (Heidel s.n., UWL). STOCKTON (Houser s.n., 21 Sep 1990, UWSP).
- Lonicera hirsuta Eaton, hairy honeysuckle. Rare, rich upland woods. MADELINE

- (Goessl 8031, MIL). OAK (near summit, SE1/4, Sec. 28; J 8409). OUTER (sight record: R. Anderson).
- \*Lonicera tatarica L., Tartarian honeysuckle. Rare relict of cultivation. ROCKY (cabin just W of sand spit; *J 6797*).
- Sambucus pubens Michaux, red-berried elder. Fairly common forest understory shrub; also on cliffs. BASSWOOD (K 8300, UWL). BEAR (J 7021). CAT (J 6128). DEVILS (J 6643). EAGLE (J 7864). GULL (dominant; J 7892). HERMIT (J 7598). IRON-WOOD (J 6222). MAINLAND (K 8559, UWL). MANITOU (J 7199). MICHIGAN (J 7416). NORTH TWIN (J 6539). OAK (Hildebrandt 289, APIS). OTTER (J 6412). OUTER (Cottam & Vogl 557, WIS). RASPBERRY (J 8018). ROCKY (Team 6, WIS). SAND (sight record: J). SOUTH TWIN (Beals AP-168, WIS). STOCKTON (Verch & Riva s.n., 14 Jul 1973, NCAW). YORK (J 7681).
- \*Viburnum opulus L., European highbush cranberry. Rare, forest edges. HERMIT (quarry edge; K 13429, 15 Jun 1982, UWL). SAND (SE1/4 of NE1/4, Sec. 13; J 8303).
- Viburnum rafinesquianum Schultes, arrow-wood viburnum. Rare, upland deciduous forests. OAK (near summit, NE<sup>1</sup>/4 of NW<sup>1</sup>/4, Sec. 34; *J 8408*). STOCKTON (near Anderson Bay; NW<sup>1</sup>/4 of NE<sup>1</sup>/4, Sec. 36; *J 8509*).
- Viburnum trilobum Marshall, American highbush cranberry. Rare. MADELINE (Cheney 5674, WIS).

## CARYOPHYLLACEAE (Pink Family)

- \*Cerastium arvense L., field chickweed. Rare garden weed. RASPBERRY (J 9931).
- \*Cerastium fontanum Baumg., mouse-ear chickweed. Common, clay bluffs and clearings. BASSWOOD (Lane 2415, WIS). BEAR (J 7116). DEVILS (J 6665). EAGLE (J 7795). GULL (occasional; J 7869). HERMIT (J 7590). IRONWOOD (J 6212). LONG (J 7969). MADELINE (Beals AP-192, WIS). MAINLAND (K 8233, UWL). MANITOU (J 7163). MICHIGAN (K 13690, UWL). NORTH TWIN (J 9649). OAK (J 8393). OTTER (J 6329). OUTER (Fraundorf 44, UWSP). RASPBERRY (Dobie 34, WIS). ROCKY (Cochrane & Cochrane 9239, WIS). SAND (J 8210). SOUTH TWIN (Verch & Riva s.n., NCAW). YORK (J 8826).
- \*Cerastium nutans Raf., nodding chickweed. Rare weed. SOUTH TWIN (airstrip; J 8842).
- Dianthus armeria L., Deptford pink. Rare weed. MADELINE (roadside, Sec. 29; J 9892).
- \*Dianthus barbatus L., sweet william. Occasional weed, clearings. BASSWOOD (Lane 2393, WIS). DEVILS (common near light; J 6706). MADELINE (Beals AP-107, WIS). MAINLAND (K 8525, UWL). MICHIGAN (Team X, UWL). ROCKY (J 6798).
- \*Myosoton aquaticum (L.) Moench, giant-chickweed. Uncommon weed, open wet sand or gravel. GULL (rare; J 7870). LONG (J 7927). SAND (J 8553).
- \*Saponaria officinalis L., bouncing bet. Uncommon relict of cultivation; rarely spreading. MADELINE (J 8819). OUTER (lighthouse woods; Fraundorf s.n., UWSP: barely persisting in 1990).
- \*Scleranthus annuus L., knawel. Rare weed, open ground. SAND (East Bay cabin; J 9300).
- \*Silene armeria L., garden catchfly. Rare weed. SAND (East Bay clearing; J 8651).
- \*Silene csereii Baumg. Rare weed. LONG (coast guard station; K 7559, UWL).
- \*Silene latifolia Poiret subsp. alba (Miller) Greuter & Burdet (Lychnis alba Miller), white campion; evening lychnis. Fairly common weed, clearings. BASSWOOD (K 8703, UWL). DEVILS (J 6650). IRONWOOD (J 6285). LONG (K 7559). MADE-LINE (J 8729). MAINLAND (K 8390, UWL). MANITOU (J 7184). MICHIGAN (J 9515). OAK (Hildebrandt 198, APIS). OUTER (J 7487). RASPBERRY (J 8970). ROCKY (J 9707). SOUTH TWIN (J 9033). STOCKTON (Lane 2523, WIS).
- \*Silene noctiflora L., night-flowering catchfly. Rare weed, clay bluffs. MADELINE (La Pointe; J 9824). RASPBERRY (lighthouse; J 9935).
- \*Silene vulgaris (Moench) Garcke (S. cucubalus Wibel), bladder campion. Uncommon weed. MADELINE (J 9890). MAINLAND (K 8546, UWL). SOUTH TWIN (Heidel

- s.n., 21 Aug 1977, UWL). STOCKTON (old field; Verch & Riva s.n., 10 Aug 1974, NCAW).
- \*Spergularia rubra (L.) J.S. & C. Presl, red sand-spurrey. Uncommon weed, open sandy ground. DEVILS (dump site; *J 6601*). MAINLAND (Little Sand Bay; *J 8584*). MANITOU (*J 9071*).
- Stellaria borealis Bigelow, stitchwort. Common, rocky or clay shores. BEAR (J 6976). CAT (J 6189). DEVILS (J 6668). HERMIT (J 9477). IRONWOOD (J 6236). MADE-LINE (Tans 915, MIL). MANITOU (J 7226). NORTH TWIN (J 6520). OAK (J 7737). OTTER (J 6325). OUTER (J 6004). RASPBERRY (K 11251, UWL). ROCKY (Cochrane & Cochrane 9341, WIS). SAND (Cheney 6170, WIS). SOUTH TWIN (J 6500). STOCKTON (K 10821, UWL). YORK (J 7672).
- Stellaria graminea L., common stitchwort. Occasional, clearings and shores. BEAR (J 7036). OAK (Hildebrandt 223, APIS). OTTER (J 6338). RASPBERRY (J 8960). SAND (J 9314).
- Stellaria longifolia Willd., long-leaved stitchwort. Common, shores and clearings. BASSWOOD (Middleton s.n., 30 Jul 1980, APIS). CAT (Lane 2273, NCAW). HER-MIT (J 9491). IRONWOOD (J 9181). LONG (J 7935). MADELINE (Beals AP-193, WIS): MANITOU (J 7151). MICHIGAN (J 7440). NORTH TWIN (J 6551). OAK (Beals AP-93, WIS). OTTER (K 12835, UWL). OUTER (J 9627). RASPBERRY (K 14038, UWL). ROCKY (Cochrane & Cochrane 9279, WIS). SOUTH TWIN (J 9030). STOCKTON (K 10804, UWL). YORK (J 7654).
- \*Stellaria media (L.) Villars, common chickweed. Rare weed. MADELINE (La Pointe; J 8763).

### CERATOPHYLLACEAE (Coontail Family)

Ceratophyllum demersum L., coontail. Uncommon, ponds. LONG (sight record: B. Middleton). MADELINE (new marina; J 9898).

#### CHENOPODIACEAE (Goosefoot Family)

- \*Chenopodium album L., lamb's quarters. Occasional weed; sometimes on clay bluffs. BEAR (W point; J 6996). EAGLE (J 7851). GULL (common; J 7893). LONG (J 8613). MADELINE (J 8766). MAINLAND (K 8527, UWL). OAK (J 9874). OUTER (N shore clay bluffs; J 7484). RASPBERRY (J 8963). SAND (J 9298).
- Chenopodium capitatum (L.) Asch., strawberry blite. Rare; not noted in present study but collected from "Apostle Islands" (Milwaukee Museum Expedition s.n., 4-7 Jul 1907, MIL).
- \*Corispermum hyssopifolium L., bugseed. Uncommon, sand dunes. LONG (Cheney 5378, WIS: still present at sand cut in 1992). MADELINE (Cheney 5583, WIS). MICHIGAN (sand spit; Middleton s.n., 11 Jul 1982, APIS).
- \*Salsola iberica Sennen & Pau, Russian-thistle; saltwort. Sand dunes. LONG (locally common; J 8589). MADELINE (Grants Point; J 9798).

#### CISTACEAE (Rockrose Family)

Hudsonia tomentosa Nutt., false heather, beach-heath, or hudsonia. Locally common, sandscapes. LONG (K 7549, WIS). MADELINE (Big Bay; Fuller 4455, MIL: also Grants Point). OUTER (Lane 2715, WIS). ROCKY (Dobie 163, WIS). SOUTH TWIN (J 6824). STOCKTON (Taylor 3649, WIS).

## COMPOSITAE (Composite Family)

Achillea millefolium L, yarrow. Common, shores, clearings, and clay bluffs. BASS-WOOD (K 8690, UWL). BEAR (J 7085). CAT (Team 6, UWL). DEVILS (Clements & Collingson D-6, UWL). EAGLE (J 7811). GULL (common; J 7884). HERMIT (Team 5, UWL). IRONWOOD (Lane 2363, WIS). LONG (K 7548, WIS). MADE-LINE (Cheney 5686, WIS). MAINLAND (K 9063, UWL). MANITOU (Team 6, UWL). MICHIGAN (Lane 2542, WIS). NORTH TWIN (sight record: J). OAK (Hildebrandt 179, APIS). OTTER (J 6420). OUTER (Team 6, UWL). RASPBERRY (Dobie 39, APIS). ROCKY (Team 6, UWL). SAND (J 8266). SOUTH TWIN (Team 3, UWL). STOCKTON (Verch & Riva s.n., 28 Jun 1973, NCAW). YORK (K 11479, UWL).

- \*Achillea ptarmica L., sneezeweed yarrow. MADELINE (escaped to roadsides near La Pointe; J 9885).
- Ambrosia artemisiifolia L., common ragweed. Rare weed. LONG (isthmus, wet sand; J 8610). MADELINE (airport; J 9827).
- \*Ambrosia coronopifolia Torrey & A. Gray, western ragweed. MADELINE (Cheney 5584, WIS). RASPBERRY (dock; J 8972).
- Anaphalis margaritacea (L.) Benth. & Hook., pearly everlasting. Common, clay bluffs, shores, and clearings. BASSWOOD (Rudd Farm; Middleton s.n., 30 Jul 1980, APIS). BEAR (J 6994). CAT (Team 2, UWL). DEVILS (Nee & Peet 1854, WIS). HERMIT (Team 6, UWL). IRONWOOD (Lane 2372, WIS). LONG (Cheney 5331, WIS). MADELINE (Cheney 5687, WIS). MAINLAND (K 9054, UWL). MANITOU (J 7140). MICHIGAN (J 7404). NORTH TWIN (J 6579). OAK (Hildebrandt 172, APIS). OTTER (Bowers 11723-a, UWSP). OUTER (J 7471). RASPBERRY (Dobie 109, APIS). ROCKY (K 11867, UWL). SAND (J 8262). SOUTH TWIN (Heidel s.n., UWL). STOCKTON (K 10000, UWL). YORK (K 11476, UWL).
- Antennaria neodioica E. Greene (A. neglecta E. Greene), cat's-foot, everlasting, or field pussy-toes. Common, clay bluffs, lawns, pine forest understories, and clearings. BASSWOOD (Team 5, UWL). BEAR (J 9726). CAT (J 6091). DEVILS (Beals s.n., WIS). HERMIT (J 7999). IRONWOOD (J 6299). LONG (J 8370). MADELINE (Seymour 11353, WIS). MAINLAND (K 8234, UWL). MANITOU (J 7245). MICHIGAN (J 7401). NORTH TWIN (J 6566). OAK (Goessl 7886, MIL). OTTER (J 6352). OUTER (J 9644). RASPBERRY (J 8038). ROCKY (J 6817). SAND (J 8194). SOUTH TWIN (Beals AP-208, WIS). STOCKTON (Beals AP-51, WIS). YORK (J 8791).
- Antennaria plantaginifolia (L.) Richardson, plantain-leaved pussy-toes. Rare. BEAR (W coast clearing; J 9736).
- \*Anthemis tinctoria L., yellow chamomile. RASPBERRY (escaped and widely spreading on clay bluff below lighthouse; *Dobie 76*, WIS).
- \*Arctium minus (Hill) Bernh., common burdock. Occasional, old clearings. BASS-WOOD (Rudd Farm; Middleton s.n., 30 Jul 1980, APIS). DEVILS (J 6642). HER-MIT (Bruder Farm; J 9484). MADELINE (Goessl 7962, MIL). MANITOU (J 7198). MICHIGAN (J 7306). OAK (sand spit and N bay; J 8403). RASPBERRY (J 8022). SAND (J 8315). STOCKTON (J 8420).
- \*Artemisia absinthium L., absinthe wormwood. Rare weed; not noted in present study. MADELINE (Cheney 5602, MIL).
- \*Artemisia biennis Willd., biennial wormwood. Rare weed. MADELINE (La Pointe and airport; J 9881).
- Artemisia campestris L., tall or beach wormwood. Common, sand dunes. BEAR (J 9083). CAT (J 6157). IRONWOOD (rare, E coast rocks; J 9204). LONG (K 9138, UWL). MADELINE (Bobb 184, WIS). MICHIGAN (J 7270). OAK (Goessl 7885, MIL). OUTER (Lane 2496, WIS). ROCKY (Dobie 160, WIS). SOUTH TWIN (Heidel s.n., UWL). STOCKTON (Verch & Riva s.n., 10 Aug 1973, NCAW).
- Aster ciliolatus Lindley, Lindley's aster. Common, forest margins. BASSWOOD (Lane 2401, NCAW). BEAR (J 6955). CAT (Team 6, UWL). DEVILS (Taylor 3689, MIL). HERMIT (J 7552). LONG (K 8973, UWL). MADELINE (Lapham s.n., Sep 1858, WIS). MAINLAND (K 9057, UWL). MANITOU (Lane 2601, NCAW). MICHIGAN (J 7399). OTTER (Bowers 11788-c, UWSP). OUTER (K s.n., UWL). RASPBERRY (J 9920). ROCKY (Clements R-7, UWL). SAND (J 8518). SOUTH TWIN (Heidel s.n., 3 Aug 1977, UWL). STOCKTON (Middleton s.n., 29 Aug 1979, APIS). YORK (J 7701).
- Aster laevis L., smooth aster. Rare. LONG (J 7965). MADELINE ("Quite common;" Goessl 8055, MIL).
- Aster lanceolatus Willd., panicled aster. Common, wetlands; occasional, shores. BASS-WOOD (Cheney 5791, MIL). BEAR (J 9108). DEVILS (J 9906). EAGLE (J 7798). HERMIT (J 9490). LONG (K 9117, UWL). MADELINE (J 9823). MAINLAND (K 9061, UWL). NORTH TWIN (J 9669). OAK (J 7742). OTTER (Bowers 11706, UWSP). OUTER (Fraundorf s.n., 6 Sep 1978, UWSP). RASPBERRY (J 9910).

ROCKY (K 11873, UWL). SAND (J 8658). SOUTH TWIN (J 9031). STOCKTON (Middleton s.n., 29 Aug 1979, APIS). YORK (J 9946).

Aster lateriflorus (L.) Britton, calico aster. Common, forest margins. BEAR (J 9740). CAT (J 9258). DEVILS (J 6631). HERMIT (J 7606). IRONWOOD (J 6297). LONG (K 9099). MADELINE (J 9805). MAINLAND (K 9076, UWL). MANITOU (Team 6, UWL). MICHIGAN (J 7394). NORTH TWIN (J 9682). OAK (J 9438). OTTER (Bowers 11738, UWSP). OUTER (Team 5, UWL). RASPBERRY (J 9921). ROCKY (K 11874, UWL). SAND (J 8645). SOUTH TWIN (J 9778). STOCKTON (K 9993, UWL).

Aster macrophyllus L., big-leaved aster. Upland woods; abundant on the larger islands, uncommon to common on the smaller ones. BASSWOOD (J 8130). BEAR (J 7094). CAT (J 6107). DEVILS (J 6711). HERMIT (J 7618). IRONWOOD (J 6214). MADELINE (Cheney 5668, WIS). MAINLAND (K 9069). MANITOU (Lane 2592, WIS). MICHIGAN (J 7268). NORTH TWIN (J 6568). OAK (Hildebrandt 275, APIS). OTTER (J 6372). OUTER (J 9564). RASPBERRY (J 6883). ROCKY (J 8894). SAND (J 8200). SOUTH TWIN (Heidel s.n., UWL). STOCKTON (K 9987, UWL). YORK (J 8803).

Aster pilosus Willd., hairy aster. Rare. LONG (Cheney 5410, WIS).

Aster puniceus L., purple-stemmed aster. Fairly common, wetlands, especially near beaver flowages. CAT (E coast; J 9225). HERMIT (J 7635). LONG (J 7964). MADE-LINE (Cheney 5614, WIS). MAINLAND (K 9055, UWL). MANITOU (J 9508). MICHIGAN (J 7415). OTTER (J 9773). SAND (J 8561). SOUTH TWIN (Heidel s.n., 5 Aug 1977, UWL). STOCKTON (K 9998, UWL). YORK (J 8817).

Aster umbellatus Miller, flat-top aster. Uncommon, moist edges and thickets. BASS-WOOD (J 9335). DEVILS (W landing; J 9972). LONG (sand cut; J 8622). MAIN-LAND (K 9074, UWL). OUTER (sight record: J, 1990). SAND (East Bay; J 8558).

Aster urophyllus Lindley, arrow-leaved aster. Rare, forest margins. OTTER (Bowers 11670, UWSP).

Bidens cernua L., sticktight. Fairly common, swamp and beaver pond margins. LONG (K 9111, UWL). MADELINE (J 9888). OUTER (Team 6, UWL). RASPBERRY (J 9915). ROCKY (Clements & Collingson 320, UWL). STOCKTON (J 9850). YORK (J 9953).

Bidens connata Willd., swamp beggar-ticks. Rare. LONG (Cheney 5399, WIS).

Bidens frondosa L., beggar-ticks. Fairly common, swamp and beaver pond margins. BASSWOOD (quarry; K 14065, UWL). MADELINE (J 9399). MICHIGAN (beaver pond, E tip; K 13882, UWL). RASPBERRY (E tip alders; J 9913). SAND (J 9795). STOCKTON (J 9852).

Bidens tripartita L. Occasional, wetlands. LONG (Claasen s.n., 9 Sep 1989, ISC). OUTER (NE1/4 of SE1/4, Sec. 13; J 9646). STOCKTON (Verch & Riva s.n., 30 Aug 1974, NCAW).

\*Centaurea biebersteinii DC., spotted knapweed. Uncommon, dry waste ground. LONG (isthmus; J 8609). MADELINE (Chebomnicon Bay roadside; J 9403).

\*Centaurea cyanus L., batchelor's button. MICHIGAN (spreading slightly from cultivation, lighthouse; J 7397).

\*Chrysanthemum balsamita L., costmary. Rarely peristing from cultivation. BASS-WOOD (McCloud Farm; Middleton s.n., 11 Aug 1980, APIS).

\*Chrysanthemum leucanthemum L., ox-eye daisy. Common, clay bluffs and clearings. BASSWOOD (Team 6, UWL). BEAR (J 7037). DEVILS (J 6687). EAGLE (J 7844). GULL (K 13917, UWL: not noted in 1991). HERMIT (Team 6, UWL). IRONWOOD (J 6270). LONG (K 7556). MADELINE (Goessl 7959, MIL). MAINLAND (K 8521, UWL). MANITOU (J 7150). MICHIGAN (J 7403). OAK (J 9445). OTTER (K 12863, UWL). OUTER (Fraundorf 45, UWSP). RASPBERRY (Dobie 128, APIS). ROCKY (Team 6, UWL). SAND (J 8517). SOUTH TWIN (Heidel s.n., UWL). STOCKTON (J 8438).

\*Cichorium intybus L., common chicory. Rare weed. MADELINE (Big Bay cam-ground; J 9390).

\*Cirsium arvense (L.) Scop., Canada thistle. Common weed, especially on clay bluffs.

BASSWOOD (*K* 8694, UWL). BEAR (*J* 7050). CAT (*J* 9019). DEVILS (*J* 6624). GULL (uncommon, *J* 7868). HERMIT (*J* 9458). IRONWOOD (*J* 9189). LONG (*K* 8796, UWL). MADELINE (*Goessl* 7953, MIL). MANITOU (*J* 7152). MICHIGAN (*J* 7439). NORTH TWIN (*J* 6583). OAK (*K* 11781). OTTER (*J* 6438). OUTER (*Fraundorf s.n.*, 6 Sep 1978, UWSP). RASPBERRY (*Middleton s.n.*, 11 Jun 1980, APIS). ROCKY (*K* 11859, UWL). SAND (*J* 8260). SOUTH TWIN (*Heidel s.n.*, UWL). STOCKTON (*J* 8418). YORK (*J* 8795).

Cirsium muticum Michaux, swamp thistle. Rare. LONG (sight record: E. Epstein, sand

cut). MADELINE (Hagen Road ditch; J 9395).

- \*Cirsium vulgare (Savi) Tenore, bull thistle. Common, clay bluffs and beaches; occasional, clearings. BEAR (J 973 I). CAT (J 6112). DEVILS (J 6644). EAGLE (J 7797). GULL (uncommon; J 7888). HERMIT (J 8070). IRONWOOD (J 9192). LONG (J 8368). MADELINE (J 871 I). MAINLAND (K 855 I, UWL). MANITOU (J 725 I). MICHIGAN (J 7385). NORTH TWIN (J 9673). OAK (J 9440). OTTER (J 8874). OUTER (J 9588). RASPBERRY (J 8946). ROCKY (Clements R-65, UWL). SAND (J 8310). SOUTH TWIN (Team 4, UWL). STOCKTON (K 10827, UWL). YORK (J 7673).
- Conyza canadensis (L.) Cronq., horseweed. Common, clay bluffs and shores. BEAR (J 9728). CAT (J 9283). DEVILS (J 9961). EAGLE (J 7791). HERMIT (J 9494). IRON-WOOD (J 9197). LONG (K 9108, UWL). MADELINE (J 9386). MAINLAND (K 8972, UWL). MICHIGAN (J 7428). NORTH TWIN (J 9670). OAK (J 7709). OTTER (Bowers 11665, UWSP). OUTER (J 9568). RASPBERRY (J 9904). ROCKY (Collingson 53, UWL). SAND (J 9782). SOUTH TWIN (Heidel s.n., UWL). STOCKTON (J 9844).
- \*Coreopsis lanceolata L., tickseed. MADELINE (spreading from introduction at revegetated gravel pit on South Shore Road; J 9405).
- \*Crepis tectorum L., hawk's beard. Uncommon weed of clearings. MADELINE (roadside, Chebomnicon Bay; *J 8731*). OUTER (base of lighthouse steps; *J 7485*). SAND (East Bay cabin; *J 9299*).
- Erigeron annuus (L.) Pers., annual fleabane. Fairly common, clay bluffs and clearings. BASSWOOD (J 8147). CAT (J 9257). EAGLE (J 7832). MADELINE (J 9394). OAK (J 9879). OTTER (J 6379). OUTER (W¹/2, Sec. 36; Fraundorf s.n., 5 Aug 1978, UWSP). SAND (J 9784). YORK (J 9947).
- Erigeron philadelphicus L., common fleabane. Occasional, clearings, trailsides, and clay bluffs. BASSWOOD (K 8693, UWL). DEVILS (J 9010). MANITOU (J 7212). MAINLAND (K 8553, UWL). MICHIGAN (J 7262). OTTER (J 8880). RASPBERRY (Dobie 183, WIS). STOCKTON (Verch & Riva s.n., 14 Jul 1973, NCAW).
- Erigeron strigosus Muhlenb., daisy fleabane. Common, clay bluffs and clearings. BEAR (J 9729). DEVILS (J 9962). LONG (J & Meeker 5294, WIS). MADELINE (Bobb 186, WIS). MANITOU (Team 3, UWL). MICHIGAN (J 9541). OAK (Hildebrandt 271, APIS). OUTER (J 9572). RASPBERRY (J 9933). ROCKY (J 9703). SOUTH TWIN (Middleton s.n., 8 Aug 1980, APIS). STOCKTON (Verch & Riva s.n., 10 Aug 1973, NCAW).
- Eupatorium maculatum L., joe-pye weed. Fairly common, alder thickets, beaver meadows, wet shores, and swampy woods. HERMIT (J 7651). IRONWOOD (J 9185). LONG (Cheney 5422, WIS). MADELINE (J 9383). MAINLAND (K 9062, UWL). OTTER (J 9756). OUTER (Fraundorf s.n., 12 Jul 1978, UWSP). RASPBERRY (J 8964). ROCKY (J 9719). SAND (J 8643). STOCKTON (Falck s.n., 13 Aug 1990, UWSP).
- Eupatorium perfoliatum L., boneset. Uncommon, wetland edges. LONG (fairly common; Cheney 5405, WIS). MADELINE (Co. H ditch; J 9833). OUTER (E¹/2, Sec. 23; Fraundorf s.n., 8 Aug 1978, UWSP). SOUTH TWIN (sight record: B. Heidel).
- Euthamia graminifolia (L.) Nutt., grass-leaved goldenrod. Fairly common, sandstone ledges, clay bluffs, and acid, sandy shores. BASSWOOD (K 14057, UWL). CAT (J 9227). DEVILS (Middleton s.n., 10 Jun 1979, APIS). GULL (Lane 2588, WIS: not noted in 1991). HERMIT (J 7532). IRONWOOD (J 9188). LONG (K 9120, UWL). MADELINE (Lapham s.n., Sep 1858, WIS). MAINLAND (K 9085, UWL). MANI-

TOU (*J 7210*). OAK (*Middleton s.n.*, 11 Jul 1980, APIS). OTTER (*Bowers 11661*). OUTER (*Tans s.n.*, 23 Aug 1971, WIS). SAND (*J 8665*). SOUTH TWIN (*Heidel s.n.*, UWL). STOCKTON (*Taylor 3593*, MIL). YORK (*Lane 2577*, NCAW).

\*Gaillardia pulchella Foug., blanket-flower. Spreading from cultivation, sometimes aggressively. MADELINE (gravel of South Shore Road; J 9404). RASPBERRY

(common on clay bluffs in front of lighthouse; Dobie 76, WIS).

Gnaphalium obtusifolium L., catfoot or sweet everlasting. Occasional, moist dune margins, clay bluffs, and clearings. LONG (sand cut; *J* 8639). MADELINE (Grants Point; *J* 9801). OUTER (open, sandy woods; *Lane* 2497, NCAW). RASPBERRY (sand spit; *J* 9919). STOCKTON (*Taylor* 3594, MIL).

Gnaphalium sylvaticum L., woodland cudweed. Rare, trailside forest edge; known in Wisconsin only from the following collection. OUTER ("Heaven's Flowage," N<sup>1</sup>/<sub>2</sub>, Sec. 24; Fraundorf s.n., 13 Sep 1978, UWSP: not relocated in present study).

- \*Gnaphalium uliginosum L., low cudweed. Occasional in wet, disturbed ground. DEV-ILS (E landing; Cochrane & Cochrane 9224, WIS). EAGLE (J 7841). MADELINE (Kron Road ditch; J 9801). RASPBERRY (lighthouse flowerbed; J 9929). SAND (J 9788).
- Helenium autumnale L., sneezeweed. MAINLAND (Little Sand Bay, Sec. 6; Stackler 74-291, CABLE).
- Helianthus giganteus L., tall sunflower. Rare, clearings. LONG (locally common, sand cut; J 8624). SOUTH TWIN (sight record: B. Heidel).
- Helianthus sp., possibly H. strumosus L. but approaching H. hirsutus Raf. (det.: M. A. Wetter). DEVILS (N tip clearing; J 9971).
- \*Hieracium aurantiacum L., orange hawkweed. Abundant, lawns, trailsides, and clearings; common, clay bluffs and shores. BASSWOOD (K 8700, WIS). BEAR (J 7118). CAT (K 12092, UWL). DEVILS (J 6730). HERMIT (Team 6, UWL). IRONWOOD (J 6211). LONG (K 7514, WIS). MADELINE (Grether 7224, WIS). MAINLAND (K 8530, UWL). MANITOU (Team X, UWL). MICHIGAN (J 7411). NORTH TWIN (J 6595). OAK (J 7724). OTTER (J 6396). OUTER (K 10953, UWL). RASPBERRY (J 6857). ROCKY (J 6791). SAND (J 8514). SOUTH TWIN (Clements ST-47, UWL). STOCKTON (K 6984, WIS). YORK (K 11378, UWL).
- \*Hieracium caespitosum Dumort. Occasional, sand spits and dry clearings. BEAR (*J* 6995). CAT (*J* 9017). OTTER (N landing; *J* 9755). ROCKY (*J* 8927). SOUTH TWIN (*J* 6847).
- \*Hieracium piloselloides Villars, king-devil. Fairly common, clearings and shores. BASSWOOD (J 9322). CAT (J 9224). DEVILS (J 6604). HERMIT (sight record: J). IRONWOOD (J 6283). LONG (J 7915). MADELINE (J 8735). MANITOU (J 9079). MICHIGAN (Middleton s.n., 22 Oct 1982, APIS). NORTH TWIN (J 6513). OAK (J 9441). OUTER (J 9565). RASPBERRY (J 9938). SOUTH TWIN (J 8834). STOCKTON (Verch & Riva s.n., 2 Aug 1973, NCAW). YORK (J 8783).
- Hieracium kalmii L., Canada hawkweed. Fairly common, pine woods, clay bluffs, and clearings. BASSWOOD (Middleton s.n., 30 Jul 1980, APIS). BEAR (J 9749). DEVILS (J 6702). HERMIT (J 7641). LONG (J 7926). MADELINE (Beals AP-132, WIS). MANITOU (J 7209). OAK (Hildebrandt 280, APIS). OUTER (Tans s.n., 23 Aug 1971, WIS). ROCKY (J 9714). SAND (J 8568). STOCKTON (Verch & Riva s.n., 9 Aug 1973, NCAW).

Hieracium scabrum Michaux, rough hawkweed. Occasional, shores and clearings. BASSWOOD (Lane 2398, NCAW). CAT (Team 6, UWL). DEVILS (K 13956, UWL). HERMIT (K 7530, WIS). LONG (K 9140, UWL). MICHIGAN (J 7274). OAK (J 9878). OUTER (Tans s.n., 23 Aug 1971, WIS). RASPBERRY (J 6885).

ROCKY (K 11861, UWL). STOCKTON (K 9984, UWL).

Lactuca biennis (Moench) Fern., blue lettuce. Fairly common, clearings, trail edges, and shores. BEAR (J 7044). CAT (Team 6, UWL). DEVILS (J 9965). HERMIT (Team 6, UWL). LONG (Cheney 5306, WIS). MANITOU (Team 6, UWL). MICHIGAN (K 13889, UWL). OTTER (Bowers 11754, UWSP). OUTER (J 9594). RASP-BERRY (K 14047, UWL). SAND (J 8660).

Lactuca canadensis L., wild lettuce. Fairly common, clearings, shores, and clay bluffs.

- BASSWOOD (Middleton s.n., 30 Jul 1980, APIS). DEVILS (J 6633). EAGLE (J 7821). HERMIT (Team 6, UWL). IRONWOOD (Lane 2358, NCAW). LONG (J 8616). MADELINE (Goessl 7998, MIL). MAINLAND (K 8969, UWL). MICHIGAN (J 7362). OAK (J 7755). OUTER (J 6397). ROCKY (J 8893). SAND (J 9786). SOUTH TWIN (J 9024). STOCKTON (J 9858). YORK (J 7658).
- \*Lactuca serriola L., prickly lettuce. Rare weed. MADELINE (La Pointe; J 9894).
- \*Leontodon leysseri (Wallr.) G. Beck, hawkbit. Occasional lawn weed on the Bayfield Peninsula. MAINLAND (Little Sand Bay fire cache cabin; J 8583).
- \*Matricaria matricarioides (Less.) Porter, pineapple- weed. Uncommon, highly disturbed ground. EAGLE (W coast ledges; J 7789). GULL (rare; J 7896). MADELINE (J 8752). MAINLAND (K 8956, UWL).
- Megalodonta beckii (Torrey) E. Greene, water-marigold. Uncommon, lagoons and ponds. LONG (K 7571-b, WIS). MADELINE (old marina; J 8752).
- Petasites frigidus (L.) Fries subsp. palmatus (Aiton) A. Gray, sweet coltsfoot. Occasional to fairly common, moist to swampy woods. BASSWOOD (J 8152). BEAR (J 6946). CAT (J 6093). DEVILS (J 6630). HERMIT (J 7623). IRONWOOD (J 6229). MADELINE (Clark s.n., 1975, WIS). MAINLAND (K 8136, UWL). MANITOU (J 7182). MICHIGAN (J 8057). OAK (J 7719). OTTER (J 6335). OUTER (J 6065). RASPBERRY (Middleton s.n., 11 Jun 1980, APIS). ROCKY (J 6811). SAND (Dorney s.n., 2 Jun 1947, WIS). SOUTH TWIN (J 6478). STOCKTON (Falck s.n., 19 Jul 1990, UWSP). YORK (Dobie 197, WIS).
- Prenanthes alba L., white lettuce. Uncommon, woods, old clearings, and cliffs. LONG (K 8760, UWL). MAINLAND (sight record: J, common, even on shaded Squaw Bay cliffs). RASPBERRY (Dobie 60, WIS). SAND (rare, Lighthouse Point trail; J 8202). STOCKTON (Sec. 28; J 9158).
- Rudbeckia hirta L., black-eyed susan. Occasional, clearings and clay bluffs. BASS-WOOD (in several clearings; Middleton s.n., 30 Jul 1980, APIS). MADELINE (common; J 9370). OUTER (airstrip in 1975; Team 6, UWL). SAND (East Bay; J 8653).
- Rudbeckia laciniata L., coneflower. ROCKY (near dock, perhaps persisting from cultivation; Dobie 195, WIS in 1976, still present in 1992).
- Senecio aureus L., golden ragwort. Rare, ravines. BASSWOOD (W dock ravine; *J 8184*). OAK (Sec. 22, wet ravine slope; *Hildebrandt 279*, APIS: not noted in present study).
- Senecio indecorus E. Greene, plains ragwort; northern squaw-weed. Sandstone ledges or less commonly clay bluffs. The following are the only Wisconsin stations. NORTH TWIN (occasional on rocks, entire E coast; *J 6555*). OUTER (rare, rocky E coast from Austad Bay to central cove; *J 7474*). ROCKY (uncommon, clay bluffs on N side of isthmus; *J 6784*, 9715).
- Senecio pauperculus Michaux, northern ragwort. Uncommon. MADELINE (old field, Big Bay state park campground; *J 9392*). STOCKTON (common, sandstone ledges on E side of Presque Isle Point; *J 7909*).
- \*Senecio vulgaris L., common groundsel. Rare weed; not noted in present study. MADELINE (Goessl 8057, MIL).
- Solidago canadensis L., Canada goldenrod. Abundant, clay bluffs, rocky shores, and clearings. BEAR (J9112). CAT (Team 6, UWL). DEVILS (J 6655). EAGLE (J 7804). GULL (uncommon; J 7874). HERMIT (J 9474). IRONWOOD (sight record: J, 1992). LONG (Richardson s.n., 9 Sep 1989, ISC). MADELINE (Beals AP-129, WIS). MAINLAND (K 9056, UWL). MANITOU (J 9056). MICHIGAN (J 7436). NORTH TWIN (J 9651). OAK (J 7759). OTTER (Bowers 11767). OUTER (Tans s.n., 23 Aug 1971, WIS). RASPBERRY (Dobie 185A, APIS). ROCKY (J 9695). SAND (J 8667). SOUTH TWIN (Heidel s.n., UWL). STOCKTON (Middleton s.n., 29 Aug 1979, APIS).
- Solidago flexicaulis L., zigzag goldenrod. MAINLAND (fairly common, ravine bottoms; mouth of Little Saxine Creek, Sec. 19; *J 8581*). OAK (rare, N coast ravine W of campsite; *J 7747*).
- Solidago gigantea Aiton, late goldenrod. Occasional, wetland edges, clay bluffs, and clearings. BASSWOOD (McCloud Farm shore; Middleton s.n., 12 Aug 1980, APIS).

EAGLE (K 13073, UWL). IRONWOOD (J 9193). LONG (Cheney 5398, MIL). MADELINE (Cheney 5739, MIL). MAINLAND (K 9056, UWL). MICHIGAN (K 13888, UWL). SAND (J 8640). STOCKTON (K 9995, UWL). YORK (J 9941).

Solidago hispida Muhlenb., hairy goldenrod. Occasional, sand spit dunes, pine woods, and sandstone cliffs and ledges. HERMIT (N tip; J 9475). LONG (K 9136, UWL).
MADELINE (Tans s.n., MIL). MAINLAND (Sand Point cliffs; J 8573). MICHIGAN (sand spit; J 7275). OAK (J 7769). STOCKTON (Taylor 3583, MIL).

Solidago juncea Aiton, early goldenrod. Uncommon, clearings. MADELINE (J 9375). Solidago nemoralis Aiton, gray goldenrod. Occasional, sand spits and dry clearings. DEVILS (J 9970). LONG (J 8608, 8618). MADELINE (Cheney 5641, MIL). OTTER (N landing; J 9753). OUTER (old airstrip; J 9606). ROCKY (J 9693). STOCKTON (Quarry Bay clearing; J 9854).

Solidago uliginosa Nutt., bog goldenrod. Fairly common, bog mats and beaver meadows; occasional in acid, peaty swales and coastal rock pools. CAT (E coast; J 9248).
 MADELINE (Cheney 5640, MIL). MICHIGAN (J 7414). OUTER (Fraundorf s.n., UWSP). RASPBERRY (J 6924). SAND (J 9027). SOUTH TWIN (airstrip; J 8300). STOCKTON (J 7908).

\*Sonchus asper (L.) Hill, spiny sow-thistle. Uncommon weed. MADELINE (Cheney 5582, WIS. La Pointe, J 9822). RASPBERRY (lighthouse bluffs; J 9932).

\*Sonchus uliginosus M. Bieb., smooth sow-thistle. Common, clay bluffs; occasional, clearings. BEAR (J 6997). CAT (J 9244). EAGLE (J 7805). HERMIT (J 9497). IRONWOOD (J 9196). LONG (J 7963). MADELINE (J 9420). MANITOU (J 7216). MICHIGAN (J 9547). NORTH TWIN (J 9668). OAK (Hildebrandt 346, APIS). OTTER (J 6397). OUTER (K 10942, UWL). RASPBERRY (J 6894). ROCKY (J 9699). SAND (J 9785). SOUTH TWIN (Heidel s.n., UWL). STOCKTON (K 9988, UWL). YORK (J 7662).

\*Tanacetum vulgare L., common tansy. Occasional weed of clearings and shores. BASSWOOD (W dock; J 9328). LONG (fairly common, sand cut; J 7947). MADE-LINE (J 8118). OUTER (lighthouse clearing; Stanley s.n., 24 Sep 1985, UWSP). SAND (J 8254). STOCKTON (Presque Isle dock; J 8437).

\*Taraxacum officinale Wigg., common dandelion. Common, clay bluffs, clearings, and shores. BASSWOOD (K 8266, WIS). BEAR (J 7103). CAT (J 6108). DEVILS (J 6688). EAGLE (J 7853). GULL (uncommon; J 7867). HERMIT (J 7539). IRONWOOD (J 6267). LONG (J 7953). MADELINE (J 8094). MAINLAND (K 8239, UWL). MANITOU (J 8043). MICHIGAN (J 7392). NORTH TWIN (J 6567). OAK (J 8043). OTTER (K 12825, UWL). OUTER (K 13444, UWL). RASPBERRY (Dobie 62, APIS). ROCKY (Dorney s.n., 2 Jun 1947, WIS). SAND (J 8253). SOUTH TWIN (sight record: J). STOCKTON (J 8434). YORK (J 7688).

\*Tragopogon dubius Scop., goat's-beard. Rare weed. MADELINE (airport; J 8773). SAND (Noring Farm; J 9315).

\*Xanthium strumarium L., cocklebur. Rare weed in dry to moist coastal sand. LONG (sand cut; J 7917). MADELINE (beach, town park, La Pointe; J 9819).

## CONVOLVULACEAE (Morning-glory Family)

Convolvulus sepium L., hedge-bindweed. Uncommon, clearings and shores. LONG (K 8780, WIS). MADELINE (Goessl 7954, MIL). MANITOU (fish camp; J 7249). STOCKTON (Presque Isle dock; J 9131).

\*Ipomoea hederacea (L.) Jacq., ivy-leaved morning-glory. Rare escape from cultivation. MADELINE (SW1/4, Sec. 21; Nell s.n., 20 Jul 1978, UWSP).

# CORNACEAE (Dogwood Family)

Cornus alternifolia L.f., pagoda or alternate-leaved dogwood. Occasional, upland deciduous woods. BASSWOOD (near Rudd Farm; *J 9354*). HERMIT (*J 7608*). MADELINE (*J 8713*). OAK (*J 8395*). OUTER (*J 6083*). SAND (near Noring Farm; *J 8326*). STOCKTON (Sec. 25; *J 8458*).

Cornus canadensis L., bunchberry. Common, woods. BASSWOOD (Lane 2392, WIS). BEAR (J 7109). CAT (J 6140). DEVILS (Taylor 3681, MIL). EAGLE (J 7802). HERMIT (Lane 2137, WIS). IRONWOOD (J 6208). LONG (J 7959). MADELINE

(McCown 28, WIS). MANITOU (J 7128). MICHIGAN (K 13675, UWL). NORTH TWIN (J 6588). OAK (Clements 1, UWL). OTTER (J 6465). OUTER (Team 3, UWL). RASPBERRY (Dobie 38, WIS). ROCKY (Clements R-39, UWL). SAND (J 8203). SOUTH TWIN (Heidel s.n., UWL). STOCKTON (Taylor 3590, MIL). YORK (K 11530, UWL).

Cornus foemina Miller, gray dogwood. Rare. OUTER (Sec. 18, beaver flowage edge; Fraundorf s.n., 5 Aug 1978, UWSP).

Cornus rugosa Lam., round-leaved dogwood. Uncommon, rich upland woods. MADE-LINE (Lapham s.n., Sep 1858, WIS). MICHIGAN (Team 2, 23 Jul 1975, UWL). OAK (Goessl 8033, MIL). OUTER (sight record: J). SOUTH TWIN (J 6506).

Cornus stolonifera Michaux, red-osier dogwood. Fairly common, wetland edges, shores, and sandstone cliffs. BASSWOOD (K 8471, UWL). BEAR (J 7029). CAT (Lane 2270, WIS). DEVILS (J 6719). EAGLE (J 7860). HERMIT (J 7578). LONG (K 7501, WIS). MADELINE (J 8085). MAINLAND (K 8372, UWL). MANITOU (J 7259). MICHIGAN (J 7402). NORTH TWIN (J 6594). OAK (Beals AP-56, WIS). OUTER (Jackson & Sheldon 201, WIS). RASPBERRY (K 11205, UWL). ROCKY (sight record: R. Dobie). SAND (Beals AP-178, WIS). SOUTH TWIN (J 6494). STOCKTON (Verch & Riva s.n., 28 Jun 1973, NCAW). YORK (K 11491, UWL).

### CRUCIFERAE (Mustard Family)

Arabis divaricarpa A. Nelson. Uncommon, sand spits. ROCKY (J 6795). SOUTH TWIN (J 6834).

Arabis glabra (L.) Bernh., tower-mustard. Rare. "Apostle Islands" (Milwaukee Museum Expedition s.n., 4-7 Aug 1907, MIL). MICHIGAN (rock shore on S side of E tip; J 7361).

Arabis hirsuta (L.) Scop., hairy rock cress. Rare. STOCKTON (sandy old field, Quarry Bay; J 8510).

Arabis laevigata (Muhlenb.) Poiret, smooth rock cress. Rare. MADELINE (limestone blocks at new marina; J 9416).

Arabis lyrata L., sand cress. Locally common, sand dunes. LONG (common; J & Meeker 5291, WIS). MADELINE (Big Bay; Hanson 1537, NCAW). MAINLAND (Cheney 6383, WIS). MICHIGAN (Lane 2794, WIS). OUTER (Lane 2700, WIS).

Armoracia lacustris (A. Gray) Al-Shehbaz & V. Bates, lake cress. Rare, wet sand. OAK (rare, sand spit; *J 7767*). STOCKTON (shallow water at outlet of Julian Bay lagoon; *J 9866*).

- \*Armoracia rusticana Gaertner, Meyer, & Scherbius, horseradish. Rarely persisting from cultivation. BASSWOOD (McCloud Farm; *J 8335*). MICHIGAN (lighthouse; *K 13686*, UWL: not seen in 1992).
- \*Barbarea vulgaris R. Br., yellow rocket. Fairly common, coasts and clearings. BASS-WOOD (K 8465, UWL). DEVILS (J 6729). EAGLE (J 7792). IRONWOOD (J 6293). LONG (K 7491). MADELINE (Beals AP-202, WIS). MAINLAND (K 8254, UWL). MANITOU (J 7195). OAK (J 8044). OTTER (K 12826, UWL). OUTER (J 7480). RASPBERRY (J 8038). SAND (J 8257). SOUTH TWIN (J 6845). STOCKTON (Verch & Riva s.n., 1 Jun 1974, NCAW).
- \*Berteroa incana (L.) DC., hoary alyssum. Rare weed. MADELINE (Chebomnicon Bay roadside; *J 8733*).
- \*Brassica kaber (DC.) Wheeler, charlock. Uncommon weed. MADELINE (Kron Road; *J 9374*). RASPBERRY (*J 9937*).
- \*Brassica rapa L., field-mustard. MAINLAND (E of Sand Bay; Cheney 6412, WIS).
- \*Capsella bursa-pastoris (L.) Medikus, shepherd's-purse. Occasional weed, mostly near buildings. DEVILS (*J* 6651). GULL (*K* 13939, UWL: not noted, 1991). MADELINE (*J* 9820). OUTER (*J* 6053). RASPBERRY (*J* 6922). SAND (*J* 9302). STOCKTON (*J* 9867).
- Cardamine pensylvanica Muhlenb., bitter cress. Occasional, shaded trailsides and seeping ravine bottoms. BASSWOOD (K 8280, UWL). BEAR (J 9115). HERMIT (K 13375, UWL). MADELINE (J 8113). OAK (ephemeral pond, Sec. 2; Hildebrandt

251, APIS). MAINLAND (K 8897, UWL). OTTER (J 6327). ROCKY (J 8928). SAND (J 8222). STOCKTON (Verch & Riva s.n., 1 Jun 1974, NCAW).

\*Erysimum cheiranthoides L., wormseed-mustard. Uncommon weed. MADELINE (J 9821). MAINLAND (K 8970, UWL). ROCKY (J 8928). SAND (J 9305).

Erysimum inconspicuum (S. Watson) MacMillan. Rare weed. SAND (lighthouse; J 8664).

\*Lepidium densiflorum Schrader, peppergrass. Uncommon weed. GULL (base of fog tower, K 13903, UWL: not noted in 1991). IRONWOOD (Collingson 222, UWL). MADELINE (J 8756). MICHIGAN (Team 5, UWL). SAND (J 9793).

\*Nasturtium officinale R.Br., watercress. Rare. MADELINE (shore of old marina; J 9899).

Rorippa islandica (Oeder) Borbas, yellow cress. Occasional, wet, sandy shores and margins of beaver flowages. BASSWOOD (Middleton s.n., 11 Aug 1980, APIS). EAGLE (J 7897). LONG (J 7925). MADELINE (J 9377). OUTER (Team 6, UWL). SAND (J 8534). SOUTH TWIN (Heidel s.n., 6 Aug 1977, UWL). STOCKTON (J 9170).

\*Sisymbrium altissimum L., tumble mustard. Rare weed. RASPBERRY (Dobie s.n., WIS, in 1976: still present, 1992).

\*Thlaspi arvense L., penny-cress. MAINLAND (Sand Bay; K 8326, UWL).

## DROSERACEAE (Sundew Family)

Drosera intermedia Hayne, spatulate-leaved sundew. Occasional, bogs. MADELINE (Beals AP-145, WIS). MICHIGAN (K 11741, UWL). OUTER (Tans s.n., 23 Aug 1971, WIS). STOCKTON (Lane 2428, Coffin 424, WIS).

Drosera linearis Goldie, linear-leaved sundew. Rare, bogs. MADELINE ("sphagnous marsh, La Pointe;" *Houghton s.n.*, 9 Aug 1832, MICH; "La Point, Lake Superior, Dr. Houghton, 19th 1-5;" WIS; sight record: R. H. Read, Big Bay bog, 1975).

Drosera rotundifolia L., round-leaved sundew. Common, bogs and peaty swales. BASSWOOD (quarry; K 14058, UWL). BEAR (J 9738). DEVILS (J 6610). LONG (K 7416, UWL). MADELINE (Beals AP-144, WIS). MAINLAND (K 8621, UWL). MICHIGAN (K 11740, UWL). OUTER (Tans s.n., 23 Aug 1971, WIS). RASP-BERRY (J 6938). ROCKY (Dobie 146, WIS). SOUTH TWIN (airstrip, present since at least 1977; Cochrane & Cochrane 9314, WIS). STOCKTON (Coffin 423, WIS).

## ERICACEAE (Heath Family)

Andromeda glaucophylla Link, bog-rosemary. Occasional, bogs. LONG (K 7500, WIS). MADELINE (Fuller 4456, MIL). MAINLAND (Cheney 6374, WIS). MICHIGAN (J 7455). OUTER (K 10908, UWL). STOCKTON (Escoll 272, MIL).

Arctostaphylos uva-ursi (L.) Sprengel, bearberry. Locally common, sand spit dunes, pine woods, and dry bluffs edges. BASSWOOD (S tip; J 8176). BEAR (J 8009). CAT (J 6153). DEVILS (Beals s.n., WIS). LONG (K 8150, WIS). MADELINE (McCown 29, WIS). MAINLAND (Cheney 6347, WIS). MANITOU (S tip; J 9081). MICHIGAN (J 7297). NORTH TWIN (sight record: W. Tans in 1977; not noted in 1991–1992). OAK (Jones s.n., WIS). OUTER (J 6081). RASPBERRY (J 6859). ROCKY (J 8900). STOCKTON (Perkins s.n., 6 Jun 1976, UWSP). YORK (J 7676).

Chamaedaphne calyculata (L.) Moench, leatherleaf. Common, bogs and swamps. BEAR (summit bog; J 7011). CAT (N tip interior swamp, rare; J 9274). DEVILS (J 6613). LONG (K 8159, WIS). MADELINE (Escoll 257, MIL). MAINLAND (K 8614, UWL). MICHIGAN (K 13705, UWL). OTTER (interior bog; J 8862). OUTER (Jackson & Sheldon 208, WIS). ROCKY (J 7467). SAND (J 8298). STOCKTON (Coffin 359, WIS).

Epigaea repens L., trailing arbutus. Occasional, woods (especially pine woods). BASS-WOOD (sight record: R. B. Brander). DEVILS (near W landing; *J* 6709). LONG (*J* 7955). MADELINE (Goessl 8041, MIL). OAK (*J* 7715). OUTER (*J* 6056). STOCK-TON (*K* 13750, UWL).

Gaultheria hispidula (L.) Bigelow, creeping snowberry. Fairly common, bogs and conifer swamps; rarely on dry, piney bluff edges. BEAR (J 7004). CAT (N tip interior swamp; J 9270). DEVILS (Taylor 3598, MIL). HERMIT (J 7648). MADELINE

- (Cheney 5693, WIS). MAINLAND (Sand Point; K 12312, APIS). MICHIGAN (J 7359). OTTER (J 6348). OUTER (J 6079). RASPBERRY (sight record: R. Dobie). ROCKY (J 6812). SAND (Cheney 6230, WIS). STOCKTON (Taylor 3685, MIL). YORK (W tip interior swamp; J 9955).
- Gaultheria procumbens L., wintergreen. Common, woods (especially pine woods). BASSWOOD (K 14066, UWL). BEAR (J 6980). CAT (J 6144). DEVILS (Taylor 3600, MIL). HERMIT (J 7617). LONG (J 7458). MADELINE (J 8093). MAINLAND (K 8240, UWL). MANITOU (J 7235). OAK (Jones s.n., WIS). OTTER (J 6480). OUTER (Team 1, UWL). SAND (Cheney 6217, WIS). STOCKTON (Taylor 3673, MIL).
- Gaylussacia baccata (Wangenh.) K. Koch, huckleberry. Locally common, sand spit pine woods. LONG (common; Cheney 5346, WIS). MADELINE (Big Bay barrier beach; Fuller 4454, MIL). OUTER (sight record: J. Van Stappen & T. Doolittle, Sand Point pine woods in 1990: not noted in present study). STOCKTON (common, W side of Presque Isle isthmus; Cochrane & Cochrane 9244, WIS).
- Kalmia polifolia Wangenh., bog-laurel. Common, bogs; occasional, coastal rock pools. BEAR (summit bog; J 7015). DEVILS (J 6747). LONG (K 7381). MADELINE (Beals AP-184, WIS). MAINLAND (K 8625, UWL). MICHIGAN (J 7451). OTTER (J 8861). OUTER (J 6067). RASPBERRY (J 6927). ROCKY (J 7469). SAND (sight record: J). SOUTH TWIN (rare, airstrip; J 9026). STOCKTON (Escoll 275, MIL). YORK (W tip rock pool; J 9957).
- Ledum groenlandicum Oeder, Labrador-tea. Common, bogs; occasional, dry, piney bluff edges. BEAR (summit bog; J 7006). CAT (sight record: J, N point interior swamp). DEVILS (abundant, N half of island; Cochrane & Cochrane 9171, WIS). LONG (K 7497, WIS). MADELINE (Cheney 5677, WIS). MICHIGAN (J 7352). OTTER (J 6350). OUTER (Team 4, UWL). ROCKY (J 6813). SAND (Cheney 6215, WIS). SOUTH TWIN (J 9125). STOCKTON (Beals AP-8, WIS). YORK (J 7682).
- Vaccinium angustifolium Aiton, lowbush blueberry. Common, sand spit forests and bluff edges; less common in bogs than V. myrtilloides. BASSWOOD (Team 6, UWL). BEAR (J 9085). CAT (J 6241). DEVILS (Beals s.n., WIS). HERMIT (Team 6, UWL). LONG (Cheney 5358, MIL). MADELINE (Goessl 8054, MIL). MAINLAND (K 8189, UWL). MANITOU (K 13574, UWL). MICHIGAN (J 7267). OAK (Middleton s.n., 11 Jul 1980, APIS). OTTER (J 6346). OUTER (Tans s.n., 23 Aug 1971, WIS). ROCKY (Clements R-95, UWL). SAND (Cheney 6229, WIS). SOUTH TWIN (J 6822). STOCKTON (Taylor 3654, MIL).
- Vaccinium macrocarpon Aiton, American or large cranberry. Fairly common, mostly in bogs. BASSWOOD (shoreline; Team 6, UWL). BEAR (summit bog; K 11162, UWL). LONG (Cheney 5348, WIS). MADELINE (Beals AP-140, WIS). MAINLAND (K 8615, UWL). MICHIGAN (J 7452). OUTER (J 7497). STOCKTON (Taylor 3643, MIL).
- Vaccinium myrtilloides Michaux, velvet-leaved blueberry. Common, bogs, pine forests, and bluff edges. BASSWOOD (J 9341). BEAR (J 9121). CAT (sand spit; K 12032, UWL). DEVILS (common; Beals s.n., WIS). HERMIT (K 13428, UWL). LONG (K 8149, UWL). MADELINE (J 8706). MAINLAND (K 8192, UWL). MANITOU (J 7230). MICHIGAN (J 9518). NORTH TWIN (rare; J 9679). OAK (J 9447). OTTER (J 8864). OUTER (Tans s.n., 23 Aug 1971, WIS). RASPBERRY (sight record: R. Dobie). ROCKY (J 9694). SAND (J 8277). STOCKTON (J 8427). YORK (J 7679).
- Vaccinium oxycoccos L., small cranberry. Common, bogs and wet, sandy-peaty areas. BEAR (summit bog; J 7014). CAT (N tip interior swamp; J 9273). DEVILS (Taylor 3679, MIL). LONG (K 7564, WIS). MADELINE (J 8708). MAINLAND (Cheney 6380, WIS). MICHIGAN (K 11739, UWL). OTTER (J 8866). OUTER (J 9618). RASPBERRY (J 6932). ROCKY (J 7466). SAND (J 8296). STOCKTON (Beals AP-15, WIS).

## EUPHORBIACEAE (Spurge Family)

\*Euphorbia cyparissias L., cypress spurge. Uncommon weed. MADELINE (Hsi 626, 1962, WIS). OUTER (edge of lighthouse clearing; J 6021).

\*Euphorbia maculata L., wartweed. Rare roadside weed. MADELINE (La Pointe; J 9893). MAINLAND (Little Sand Bay; J 8578).

## FAGACEAE (Beech Family)

Quercus ellipsoidalis E. J. Hill, Hill's oak. Rare. LONG (possibly hybridizing with Q. rubra; Tans 1450, MIL).

Quercus rubra L., red oak. Common, dryish woods. BASSWOOD (sight record: J, common, 1992). BEAR (J 7093). CAT (Team 6, UWL). HERMIT (Lowe s.n., 19 Aug 1975, NCAW). IRONWOOD (J 6230). LONG (K 7387). MADELINE (Cheney 5615, WIS). MANITOU (J 7147). MICHIGAN (J 7263). NORTH TWIN (single large tree at N tip on W coast opposite cabin; J 9685). OAK (J 7773). OTTER (J 6403). OUTER (Fraundorf s.n., 30 Jun 1978, UWSP). RASPBERRY (single large tree on sand spit trail; J 9923). ROCKY (J 8903). SAND (J 8256). SOUTH TWIN (J 8941). STOCKTON (Kieckhefer s.n., WIS). YORK (sight record: R. Dobie).

## FUMARIACEAE (Fumitory Family)

Corydalis aurea Willd., golden corydalis. Rare. MADELINE (open disturbed sand, Big Bay, Sec. 19; Freckmann 12895, UWSP).

Corydalis sempervirens (L.) Pers., pale corydalis. Uncommon, coastal clay bluffs. MICHIGAN (near lighthouse; *J 9549*). OAK (S shore; *Hildebrandt 248*, APIS). OTTER (*Lane 2198*, WIS). ROCKY (S shore; *J 6803*).

Dicentra cucullaria (L.) Bernh., dutchman's breeches. Rare. GULL (in shade of Sambucus pubens; Middleton s.n., 25 May 1979, APIS).

### GENTIANACEAE (Gentian Family)

Gentiana andrewsii Griseb., closed gentian. Rare, wet sand. LONG (sand cut; Tans 1907, MIL).

Halenia deflexa (Smith) Griseb., spurred-gentian. Moist woods. MADELINE (Cheney 5603, WIS). MAINLAND (common in logged woods, Sec. 3, SW of Sand Point; J 8570)

### GERANIACEAE (Geranium Family)

Geranium bicknellii Britton, Bicknell's cranesbill. Uncommon, clay bluffs, gravelly shores, and wet trails. MADELINE (Cheney 5685, WIS). MICHIGAN (K 13890, UWL). OTTER (Lane 2671, WIS). SAND (mud of West Bay beaver flowage; J 8535).

# HALORAGACEAE (Water-milfoil Family)

Myriophyllum exalbescens Fern. Occasional, shallow water; often washed up on shore. LONG (J 8345). MADELINE (marina; J 9896). STOCKTON (Presque Isle dock; J 9863).

Myriophyllum heterophyllum Michaux. LONG (bayshore of sand cut; J 8364).

Myriophyllum verticillatum L. Rare. MADELINE (Cheney 5595, WIS).

Myriophyllum sp. STOCKTON (3 m deep in Presque Isle Bay; Radomski s.n., 30 Sep 1984, UWSP).

# HAMAMELIDACEAE (Witch-hazel Family)

Hamamelis virginiana L., witch-hazel. OAK (uncommon, upper S-facing slopes and ravines; Hildebrandt 196, APIS).

# HIPPURIDACEAE (Mare's-tail Family)

Hippuris vulgaris L., mare's-tail. MAINLAND (Sand River estuary, 1 m deep in still water; Rosburg s.n., 17 Sep 1988, ISC).

# HYPERICACEAE (St. John's-wort Family)

Hypericum majus (A. Gray) Britton. Fairly common, wet sandy-peaty swales, beaver pond margins, and rock pool margins. BASSWOOD (Cheney 5780, WIS). DEVILS (K 13961, UWL). LONG (Cheney 5426, WIS). MADELINE (J 9800). NORTH

TWIN (J 9687). OUTER (J 9578). SAND (J 8292). SOUTH TWIN (airstrip; Heidel s.n., 10 Aug 1977, UWL). STOCKTON (Taylor 3592, MIL).

\*Hypericum perforatum L., common St. John's-wort. Fairly common, clearings and clay bluffs. BASSWOOD (Middleton s.n., 30 Jul 1980, APIS). BEAR (J 6983). DEVILS (J 6608). HERMIT (J 7637). IRONWOOD (J 6244). LONG (J 7945). MADELINE (Goessl 8032, MIL). MAINLAND (K 8563, UWL). MANITOU (Lane 2595, WIS). OAK (Middleton s.n., 11 Jul 1980, APIS). OTTER (J 9771). OUTER (J 6086). RASPBERRY (J 9934). ROCKY (J 8923). SOUTH TWIN (Heidel s.n., UWL). YORK (J 7665).

Triadenum fraseri (Spach) Gleason, marsh St. John's-wort. Fairly common, bogs and beaver meadows. LONG (Gull s.n., 9 Sep 1989, APIS). MADELINE (J 8700). MAINLAND (Sand River bog; Hemesath s.n., 17 Sep 1989, ISC). MICHIGAN (Lane 2541, NCAW). OUTER (Team 6, UWL). ROCKY (Dobie 159-a, WIS).

STOCKTON (K 10010, UWL).

### LABIATAE (Mint Family)

Dracocephalum parviflorum Nutt., American dragonhead. Rare. MICHIGAN (one clump on clay bluffs just E of lighthouse; J 9545).

\*Galeopsis tetrahit L., hemp-nettle. Fairly common, clearings, trails, and shores. BASSWOOD (K 8652, UWL). DEVILS (J 6609). GULL (Lane 2586, WIS. fairly common, J 7886). HERMIT (Cottam & Vogl 653, WIS). LONG (J 8601). MADE-LINE (Houghton s.n., 7-11 Aug 1832, MICH. Cheney 5664, WIS). MAINLAND (K 8550, UWL). MANITOU (Team 1, UWL). OAK (Goessl 7893, MIL). OTTER (J 6417). OUTER (J 7996). ROCKY (J 6792). SAND (J 9301). STOCKTON (K 10797, WIS). YORK (Dobie 188, WIS).

\*Glechoma hederacea L., gill-over-the-ground. Occasional lawn weed. MADELINE (Goessl 7994, MIL). MICHIGAN (J 7383). RASPBERRY (Dobie 43, WIS). SAND

(lighthouse; J 8195).

Lycopus americanus Muhlenb., cut-leaved water-horehound. Occasional, wetlands. BASSWOOD (Lane 2417, NCAW). EAGLE (J 7810, UWL). LONG (Cheney 5396, WIS). MADELINE (marina marsh; J 9413). MAINLAND (K 8913, UWL). MICHIGAN (K 13881, UWL). OAK (dock ravine; J 9875). RASPBERRY (K 14050, WIS). STOCKTON (K 10018, UWL).

Lycopus uniflorus Michaux, northern bugleweed. Common, swamps, alder thickets, bog edges, and shores. BASSWOOD (Middleton s.n., 30 Jul 1980, APIS). BEAR (J 7084). CAT (J 9264). HERMIT (J 7570). IRONWOOD (J 6296). LONG (Kimber s.n., 9 Sep 1989, ISC). MADELINE (J 9372). MAINLAND (K 8930C, UWL). MANITOU (J 7146). MICHIGAN (J 7372). NORTH TWIN (J 6528). OAK (J 7768). OTTER (J 9772). OUTER (K 10938, UWL). RASPBERRY (Dobie 190, APIS). ROCKY (Dobie 149, WIS). SAND (J 9310). SOUTH TWIN (Heidel s.n., 4 Aug 1977, UWL). STOCKTON (J 9857). YORK (J 7693).

Mentha arvensis L., field-mint. Occasional, moist clearings, swampy edges, and ravine mouth marshes. BEAR (NE clearing; J 7042). DEVILS (J 9969). LONG (Cheney 5323, WIS). MADELINE (Goessl 7971, MIL). MAINLAND (K 8914, UWL). MANITOU (J 9036). MICHIGAN (J 9544). OAK (J 9430). OUTER (Team 6, UWL). SAND (J 8540). SOUTH TWIN (Heidel s.n., UWL). STOCKTON (Verch & Riva s.n., 9 Aug 1973, NCAW).

\*Mentha citrata Ehrh., lemon-mint. Rare weed. OUTER ("open field, moderately common;" Stanley s.n., 30 Sep 1985, UWSP).

\*Monarda fistulosa L., wild bergamot. Uncommon, clearings. MADELINE (Hsi 628, WIS). MICHIGAN (rare; J 9548). OAK (old field at sand spit; Hildebrandt 210, APIS).

\*Nepeta cataria L., catnip. Uncommon weed. OAK (sand spit clearing; J 9448). RASP-BERRY (dock; Dobie s.n., WIS).

Physostegia virginiana (L.) Benth., false dragonhead. Rare, open wetlands. LONG (uncommon, sand cut; J 7932). MAINLAND (mouth of Saxine Creek; J 8579). Prunella vulgaris L., selfheal; heal-all. Common, trails, clearings, shores, and clay

bluffs. BASSWOOD (K 8651, UWL). BEAR (J 7053). CAT (Team 1, UWL). DEV-ILS (J 6653). EAGLE (J 7833). HERMIT (J 7538). IRONWOOD (J 6204). LONG (J 7919). MADELINE (Goessl 7967, MIL). MAINLAND (K 8564). MANITOU (J 7131). MICHIGAN (J 7438). OAK (Beals AP-98, WIS). OTTER (Bowers 11740, UWSP). OUTER (Stanley s.n., 22 Sep 1985, UWSP). RASPBERRY (K 14039, UWL). ROCKY (Clements R-81, UWL). SAND (J 8247). SOUTH TWIN (Heidel s.n., UWL). STOCKTON (K 10803, UWL).

\*Satureja vulgaris (L.) Fritsch, wild basil. Fairly common, clearings and trails. BASS-WOOD (Lane 2410, UWL). HERMIT (J 9480). MADELINE (Goessl 8024, MIL). MANITOU (*Team 6*, UWL). MICHIGAN (*J 7430*). OAK (*J 7710*). OUTER (*J 9592*). RASPBERRY (Dobie 129, WIS). ROCKY (J 6764). SOUTH TWIN (J 6835).

STOCKTON (J 8477).

Scutellaria galericulata L., common skullcap. Fairly common, marshes, beaver flowages, and alder thickets. BASSWOOD (K 8731). BEAR (J 9099). LONG (K 7537, WIS). MADELINE (J 8701). MICHIGAN (J 7444). OAK (J 7762). OUTER (Lane 2710, WIS). RASPBERRY (J 6903). ROCKY (Team 1, UWL). SOUTH TWIN (Heidel s.n., UWL). STOCKTON (Verch & Riva s.n., 24 Jul 1973, NCAW). YORK (J7670).

Scutellaria lateriflora L., mad-dog skullcap. Common, swampy woods, beaver flowage and bog margins, and alder thickets. BASSWOOD (J 9334). BEAR (J 7052). CAT (J 6133). HERMIT (J 7549). IRONWOOD (J 9180). LONG (Isenhart s.n., 16 Sep 1989). MADELINE (*J 8693*). MAINLAND (*K 8896*, UWL). MANITOU (*J 7174*). MICHIGAN (Team 5, UWL). NORTH TWIN (J 6563). OAK (K 11681, UWL). OUTER (Team 1, UWL). RASPBERRY (J 8954). ROCKY (Collingson 26, UWL). SAND (Massopeist s.n., Jul 1980, UWSP). SOUTH TWIN (Heidel s.n., UWL). STOCKTON (Verch & Riva s.n., 10 Aug 1973, NCAW). YORK (J 7697).

Stachys palustris L., woundwort. Occasional, clearings and wetland edges. BASS-WOOD (K 8734, WIS). DEVILS (lighthouse; K 13981, UWL). LONG (K 8766-a, UWL). MANITOU (NW clearing; J 9058). OAK (J 7712). OTTER (Bowers 11698,

UWSP).

Stachys tenuifolia Willd., rough hedge-nettle. Occasional, wet thickets and clearings. LONG (K 8766, WIS). MADELINE (Goessl 7969, MIL; J 9365). OTTER (J 6373). OUTER (sight record: R. Anderson). STOCKTON (J 9147).

### LEGUMINOSAE (Bean Family)

Amphicarpaea bracteata (L.) Fern., hog-peanut. Rare; not noted in present study. MANITOU (Lane 2603, NCAW).

Astragalus canadensis L., Canada milk vetch. Rare, shores; not noted in present survey. MAINLAND (Sand Bay to Squaw Bay; Cheney 6451, 25 June 1897, WIS).

\*Caragana arborescens Lam., Siberian pea-tree. Rare. MAINLAND (persisting from cultivation at Little Sand Bay; J 8513).

\*Coronilla varia L., crown-vetch. Rare. MADELINE (new marina edge; J 9419).

Desmodium canadense (L.) DC., showy tick-trefoil. Rare; not noted in present study. BASSWOOD (Rudd Farm, pond edge; Middleton s.n., 30 Jul 1980, APIS).

Lathyrus japonicus Willd., beach pea. Common, sandscapes; uncommon, gravelly and rocky shores. BASSWOOD (J 8166). BEAR (J 7114). CAT (K 12070). DEVILS (J 6663). GULL (rare, J 7880). HERMIT (J 7579). IRONWOOD (J 6259). LONG (Cheney 5408, WIS). MADELINE (Goessl 7989, MIL). MAINLAND (K 8385, UWL). MANITOU (J 7158). MICHIGAN (K 11764, UWL). NORTH TWIN (S tip; J 9671). OAK (Jones s.n., WIS). OTTER (J 6426). OUTER (J 7507). RASPBERRY (Dobie 40, APIS). ROCKY (Team 6, UWL). SAND (J 8279). SOUTH TWIN (Heidel s.n., 2 Aug 1977, UWL). STOCKTON (Kieckhefer s.n., WIS). YORK (K 11922, UWL).

\*Lathyrus latifolius L., everlasting pea. Uncommon, roadsides and steep lake banks. MADELINE (La Pointe; J 9410). MICHIGAN (lighthouse steps; J 9543). OUTER (lighthouse steps; J 6020).

Lathyrus ochroleucus Hooker, pale pea. Occasional, clearings, shores, and dry woods.

- BASSWOOD (*K 8459*, UWL). HERMIT (*J 9488*). MICHIGAN (*K 13666*, UWL). OAK (aspen copse S of dock; *J 9880*). RASPBERRY (*K 11210*, UWL).
- Lathyrus palustris L., marsh-vetchling. Uncommon, shores and clearings. BASS-WOOD (W dock; J 9323). LONG (Cheney 5404, WIS). MICHIGAN (J 7300).
- \*Lotus corniculatus L., birdsfoot-trefoil. Fairly common, lawns near dwellings; also shores. DEVILS (*J* 6695). LONG (*J* 8598). MADELINE (*J* 8720). RASPBERRY (*J* 8973). SAND (*J* 8312). STOCKTON (*J* 9869).
- \*Lupinus polyphyllus Lindley, garden lupine. Spreading from cultivation. DEVILS (barely persisting; J 6723). MADELINE (fairly common, roadsides; J 8728). MAINLAND (K 8533, UWL). MICHIGAN (lighthouse; K 13692, UWL). SAND (J 8265).
- \*Medicago lupulina L., black medick. Occasional, lawns and old fields. BASSWOOD (J 9332). DEVILS (J 6694). MADELINE (J 8730). MICHIGAN (J 7429). RASP-BERRY (J 8966).
- \*Medicago sativa L., alfalfa. Uncommon, clearings. DEVILS (S landing; *J* 6648). LONG (K 7561, WIS). MADELINE (J 9397).
- \*Melilotus alba Medikus, white sweet clover. Uncommon, weedy places. GULL (fairly common; K 13906, UWL. J 7877, WIS). LONG (sand cut; J 8634). MADELINE (airport; J 8768). MAINLAND (K 9077, UWL).
- \*Melilotus officinalis (L.) Pallas, yellow sweet clover. Rare, roadside. MADELINE (Grants Point; J 9406).
- \*Robinia pseudo-acacia L., black locust. Rare. SAND (persisting in old field N of East Bay; Middleton s.n., 17 Jun 1980, APIS).
- \*Trifolium aureum Pollich, yellow hop-clover. Occasional to fairly common, clearings and shores. BASSWOOD (Middleton s.n., 30 Jul 1980, APIS). BEAR (J 7034). HERMIT (Team 6, UWL). LONG (J 8363). MADELINE (J 9357). MAINLAND (K 8562, UWL). MANITOU (J 9073). MICHIGAN (J 7417). OAK (J 9433). OUTER (J 6022). ROCKY (J 9712). SAND (J 9317). SOUTH TWIN (Cochrane & Cochrane 9310, WIS). STOCKTON (Verch & Riva s.n., 2 Aug 1978, NCAW).
- \*Trifolium hybridum L., alsike clover. Fairly common, clearings and shores. BASS-WOOD (Middleton s.n., 30 Jul 1980, APIS). BEAR (J 7038). CAT (J 9259). DEVILS (J 6646). HERMIT (Team 6, UWL). IRONWOOD (J 9213). LONG (J 8596). MADELINE (J 8718). MANITOU (J 7145). MICHIGAN (J 7418). OAK (J 9443). OTTER (J 9769). OUTER (J 7488). RASPBERRY (J 9901). ROCKY (J 9705). SAND (J 8520). SOUTH TWIN (J 6840). STOCKTON (Verch & Riva s.n., 28 Jun 1973, NCAW).
- \*Trifolium pratense L., red clover. Common, clearings and shores. BASSWOOD (K 8702, UWL). BEAR (J 7039). DEVILS (J 6645). GULL (K 13925, UWL). HERMIT (Team 6, UWL). IRONWOOD (J 9212). LONG (J 8607). MADELINE (J 7972). MAINLAND (K 8562, UWL). MANITOU (J 7253). MICHIGAN (J 7405). OAK (Hildebrandt 243, APIS). OTTER (J 6394). OUTER (J 7481). RASPBERRY (Dobie s.n., WIS). ROCKY (J 8918). SAND (J 8250). SOUTH TWIN (Clements ST-57, UWL). STOCKTON (J 8463).
- \*Trifolium repens L., white clover. Common, clearings and shores. BASSWOOD (Team 6, UWL). BEAR (J 7023). CAT (J 6095). DEVILS (J 6656). GULL (K 13935, UWL). HERMIT (J 9486). IRONWOOD (J 6238). LONG (K 7562, UWL). MADELINE (J 8712). MAINLAND (K 8538, UWL). MANITOU (J 7197). MICHIGAN (Team 2, UWL). OAK (J 7711). OTTER (J 6437). OUTER (J 7486). RASPBERRY (Dobie 85, WIS). ROCKY (K 11875, UWL). SAND (J 8515). SOUTH TWIN (Clements ST-58, UWL). STOCKTON (J 8441).
- Vicia americana Willd., purple vetch. Occasional, shores and sandscapes. BEAR (J 6988). HERMIT (Team 6, UWL). MADELINE (J 8774). MAINLAND (K 8386, UWL). MANITOU (J 9082). MICHIGAN (J 9542). OAK (Beals AP-80, WIS). OTTER (J 6431). OUTER (Fraundorf s.n., 16 Jul 1978, UWSP). STOCKTON (fairly common; J 8417).
- \*Vicia angustifolia Reichard, narrow-leaved vetch. Uncommon, clearings and roadsides. BASSWOOD (E shore clearing; J 9346). MADELINE (La Pointe; J 9423). SAND (Shaw Farm; J 9291).

\*Vicia cracca L., tufted vetch. Rare. LONG (sand cut; J 7934). OUTER (bluff in front of lighthouse; J 6023).

\*Vicia villosa Roth, hairy vetch. Occasional, old fields and clearings. BASSWOOD (K s.n., 19 Jun 1975, UWL). DEVILS (dump; J 9968). MADELINE (J 9409). MANITOU (fish camp; J 9512). SAND (East Bay; J 9297).

### LENTIBULARIACEAE (Bladderwort Family)

Pinguicula vulgaris L., butterwort. N-facing, wet, mossy, cliffs and ledges (for autoecological studies see Gurnoe 1981, Milfred 1981, Jonas 1982). DEVILS (common; Taylor 3703, MIL). IRONWOOD (fairly common; J 7911). OTTER (fairly common; Taylor 3637, MIL). OUTER (uncommon, N-facing cilffs in central and southern E coast coves; J 9569).

Utricularia cornuta Michaux, horned bladderwort. Locally common, bog mats and dune pools. MADELINE (Big Bay and Amnicon Bay bogs; Beals AP-146, WIS).
 MAINLAND (Sand River bog; J 9871). MICHIGAN (K 11718, UWL). OUTER (Cottam & Vogl 623, WIS). STOCKTON (Taylor 3646, MIL).

Utricularia intermedia Hayne, flat-leaved bladderwort. Occasional, bogs and beaver ponds. LONG (K 8794, UWL). MADELINE (Beals AP-164, WIS). MAINLAND (Cheney 6351, WIS). MICHIGAN (sight record: W. Tans, 1971). OUTER (sight record: W. Tans, 1971). RASPBERRY (Dobie 90, WIS). ROCKY (sight record: W. Tans, 1971). STOCKTON (K 10791, UWL).

Utricularia resupinata Greene, small purple bladderwort. STOCKTON (occasional, dune and bog pool edges, Julian Bay; K 10025, UWL).

Utricularia vulgaris L., common bladderwort. Occasional, bog lagoons. MAINLAND (K 8597, UWL). MICHIGAN (K 11733, UWL). OUTER (Lane 2518, WIS). STOCKTON (Verch & Riva s.n., 20 Jun 1973, NCAW).

## LINACEAE (Flax Family)

\*Linum usitatissimum L., common flax. Rare weed. MADELINE (old gravel pit 1 mi. SW of Chebomnicon Bay; *J 8736*).

### LORANTHACEAE (Mistletoe Family)

Arceuthobium pusillum Peck, dwarf mistletoe. Occasional, bogs; a parasite on Picea mariana. DEVILS (sight record: T.S. Cochrane, 1 Jul 1980). MADELINE (sight record: R. H. Read, 1971). OTTER (interior bog; J 8865). SAND (East Bay bog; J 8301). STOCKTON (bogs in Sec. 24 and 36; J 9862).

# LYTHRACEAE (Loosestrife Family)

\*Lythrum salicaria L., purple loosestrife. An aggressive weed of wetlands. LONG (common in 1992 at sand cut, first appearing here about 1988; Middleton s.n., ISC). MADELINE (fairly common near La Pointe, airport, and old marina; J 9807).

### MALVACEAE (Mallow Family)

\*Malva moschata L., musk mallow. Occasional persisting and spreading from cultivation. MADELINE (Gerst s.n., WIS). MAINLAND (end of Ridge Road, Sec. 6 of T51N, R4W; J 9873). OUTER (Lullaby logging camp; J 9642). RASPBERRY (dock; Dobie s.n., WIS). SAND (Beals AP-180, WIS).

\*Malva neglecta Wallr., common mallow. Rarely persisting. OUTER (Lullaby logging camp; J 6087, WIS).

#### MENYANTHACEAE (Buckbean Family)

Menyanthes trifoliata L., buckbean. Locally abundant, bogs. LONG (Cheney 5397, WIS). MADELINE (Beals AP-183, WIS). MAINLAND (Hemesath s.n., 17 Sep 1988, ISC). MICHIGAN (K 13713, UWL). OUTER (Lane 2711, WIS). RASP-BERRY (Dobie 91, WIS). ROCKY (J 9690). STOCKTON (Escoll 259, MIL).

## MORACEAE (Mulberry Family)

\*Cannabis sativa L., marijuana. Rare. STOCKTON (cultivated in sandy soil near Julian Bay; Verch & Riva s.n., 25 Jul 1973, NCAW).

### MYRICACEAE (Bayberry Family)

Myrica gale L., sweet gale. Common, shrub layer of bogs; less common, rock pools. LONG (Cheney 5424, WIS). MADELINE (Goessl 7966, MIL). MAINLAND (K 8257, UWL). MICHIGAN (J 9533). NORTH TWIN (W coast rock pool; J 6526). OAK (sand spit; J 7763). OUTER (Lane 2161, WIS). RASPBERRY (J 6911). ROCKY (J 7468). SAND (J 8666). SOUTH TWIN (J 6482). STOCKTON (Coffin 374-a, WIS). YORK (ledges; J 8793).

## NYMPHAEACEAE (Water-lily Family)

Brasenia schreberi J. Gmelin, water-shield. Occasional, lagoons. MADELINE (Cheney 5598, WIS). MICHIGAN (K 11726, UWL). STOCKTON (Falck s.n., 13 Aug 1990, UWSP).

Nuphar luteum (L.) Sibth. & Smith, yellow pond-lily; bullhead-lily. Fairly common, lagoons and beaver ponds. LONG (K 7569, WIS). MADELINE (Goessl 7956, MIL). MAINLAND (K 8600, UWL). MICHIGAN (J 9530). OUTER (Lane 2713, WIS). STOCKTON (J 8470).

Nymphaea odorata Aiton, white water-lily. Occasional, ponds and lagoons. LONG (floating bog S of lighthouse; Mauk s.n., 16 Sep 1989, APIS). MADELINE (sight record: W. Tans & R. H. Read, 1971). STOCKTON (K 8837, UWL).

### **OLEACEAE** (Olive Family)

Fraxinus nigra Marshall, black ash. Fairly common, swampy woods near sand spit bogs and in island interiors. CAT (J 6130). DEVILS (sight record: W. Tans, 1977). EAGLE (a single tree; J 7788). HERMIT (J 7547). IRONWOOD (J 6209). MADE-LINE (Goessl 7986, MIL). MAINLAND (K 8936, UWL). MANITOU (sight record: R. B. Brander, 1978). MICHIGAN (J 7330). OAK (J 7782). OTTER (J 6464). OUTER (sight records: R. B. Brander, J). RASPBERRY (J 8959). ROCKY (Lane 2775, WIS). SAND (J 8274). STOCKTON (J 8462). YORK (J 9949).

Fraxinus pennsylvanica Marshall, green ash. Occasional, upland and lowland woods, also seedlings in wet sand near docks. BASSWOOD (common near summit, McCloud Farm; Middleton s.n., 11 Aug 1980, APIS). HERMIT (J 9473). LONG (K 8785, UWL). MADELINE (Cheney 5672, WIS). MANITOU (J 9041). MICHIGAN (J 9519). OAK (J 7734). OUTER (J 7506). SAND (J 9295). SOUTH TWIN (J 6497). STOCKTON (J 7897).

\*Syringa vulgaris L., common lilac. Long-persisting near lighthouses. DEVILS (*J 9977*). MADELINE (sight record: J, commonly cultivated). MICHIGAN (*J 7406*). OUTER (*J 9587*). ROCKY (*J 8890*). SAND (sight record: J).

### ONAGRACEAE (Evening-primrose Family)

Circaea alpina L., enchanter's-nightshade. Fairly common, moist woods and ravine bottoms. BASSWOOD (K 8660, UWL). BEAR (J 7061). CAT (Team 1, UWL). EAGLE (J 7855). GULL (rare, J 7881). HERMIT (K s.n., 15 Jul 1975, UWL). IRONWOOD (J 6233). MADELINE (Goessl 7921, MIL). MAINLAND (K 8638, UWL). MANITOU (Team 5, UWL). MICHIGAN (J 7321). NORTH TWIN (J 9667). OAK (Hildebrandt 190, APIS). OTTER (K 11625, UWL). RASPBERRY (Dobie 82, WIS). ROCKY (J 6771). SAND (Massopeist s.n., Jul 1980, UWSP). SOUTH TWIN (J 8849). STOCKTON (Lane 2347, NCAW). YORK (K 11423, UWL).

Epilobium angustifolium L., fireweed. Abundant, clearings and shores. BASSWOOD (K 8695, UWL). BEAR (J 9084). CAT (Team 5, UWL). DEVILS (Clements & Collingson D-4, UWL). EAGLE (J 7852). GULL (occasional, K 13945). HERMIT (Team 6, UWL). IRONWOOD (J 6258). LONG (Cheney 5419, WIS). MADELINE (Nell s.n., 20 Jul 1978, WIS). MAINLAND (K 8548, UWL). MANITOU (J 7148). MICHIGAN (J 9540). NORTH TWIN (J 6574). OAK (Hildebrandt 159, APIS). OTTER (K 11561, UWL). OUTER (Lane 2503, WIS). RASPBERRY (K 14026, UWL). ROCKY (Team 1, UWL). SAND (J 9540). SOUTH TWIN (Team 4, UWL). STOCKTON (Verch & Riva s.n., 13 Jul 1973, NCAW). YORK (K 11488, UWL). Epilobium ciliatum Raf., northern willow-herb. Common, wetlands, shores, and clay

bluffs. BASSWOOD (*Lane 2402*, WIS). CAT (*J 9256*). DEVILS (*J 6716*). EAGLE (*J 7992*). HERMIT (*J 7589*). IRONWOOD (*J 6239*). MADELINE (*Cheney 5671*, WIS). MAINLAND (*J 8966*). MANITOU (*Team 1*, 31 Jul 1975, UWL). MICHIGAN (*J 7353*). NORTH TWIN (*J 9660*). OAK (*J 7741*). OTTER (*J 6418*). OUTER (*J 9638*). RASPBERRY (*J 9908*). ROCKY (*Collingson 41*, UWL). SAND (*J 8268*). SOUTH TWIN (*J 8938*). STOCKTON (*J 8430*). YORK (*J 9942*).

Epilobium coloratum Biehler, purple-leaved willow-herb. Fairly common, shores and wetlands. BASSWOOD (K 8706, UWL). BEAR (J 6975). HERMIT (J 7540). LONG (K 9008, UWL). MAINLAND (K 8966, UWL). OAK (J 9877). ROCKY (Collingson 42, UWL). STOCKTON (Fraundorf s.n., 14 Aug 1978, UWSP). YORK (K 11472, UWL).

Epilobium leptophyllum Raf., bog willow-herb. Occasional, bogs and swamps. LONG (W tip; J 8605). MICHIGAN (J 7453). OUTER (J 9645). RASPBERRY (K 14051, UWL). ROCKY (Dobie 159-b, WIS). SOUTH TWIN (Heidel s.n., 14 Aug 1977, UWL). YORK (K 11471, UWL).

Oenothera oakesiana (A. Gray) S. Watson & J. Coulter, evening-primrose. Common, sandscapes, shores, and clearings. BASSWOOD (J 8182). BEAR (J 8001). CAT (Team 5, UWL). DEVILS (J 6700). HERMIT (J 7586). IRONWOOD (J 6263). LONG (Cheney 5412, WIS). MADELINE (J 8115). MAINLAND (K 8535, UWL). MANITOU (J 7159). MICHIGAN (Team 5, UWL). NORTH TWIN (J 9678). OAK (K 10716, UWL). OTTER (J 6425). OUTER (Jackson & Sheldon 206, WIS). RASP-BERRY (K 14040, UWL). ROCKY (Clements R-34, UWL). SAND (J 8322). SOUTH TWIN (Clements ST-53, UWL). STOCKTON (Lane 2532, WIS). YORK (Lane 2582, WIS).

Oenothera parviflora L., evening-primrose. Rare. YORK (K 11478, UWL).

## OROBANCHACEAE (Broom-rape Family)

Conopholis americana (L.) Wallr., squawroot. Parasitic on roots of Quercus rubra. OAK (occasional, S part of island, from sand spit trail to near summit; K 10726, UWL).

### OXALIDACEAE (Wood-sorrel Family)

Oxalis montana Raf., common wood-sorrel. Occasional, mixed or coniferous woods. BEAR (J 6954). DEVILS (J 6720). MADELINE (Goessl 7942, MIL). MAINLAND (K 8640, UWL). MICHIGAN (J 7355). OAK (Hildebrandt 253, APIS). OUTER (common, virgin hemlocks; Fraundorf s.n., 4 Jul 1978, UWSP). STOCKTON (Beals AP-27, WIS).

Oxalis stricta L., yellow wood-sorrel. Occasional, clearings and trails. DEVILS (J 6691). HERMIT (J 7627). MADELINE (J 8757). MAINLAND (K 8565, UWL). OUTER (J 9603). SAND (J 8234). SOUTH TWIN (Heidel s.n., UWL). STOCKTON (J 8446).

## PAPAVERACEAE (Poppy Family)

Sanguinaria canadensis L., bloodroot. Rare, woods; not noted in present study. STOCKTON (R. Verch photograph No. 35).

# PLANTAGINACEAE (Plantain Family)

\*Plantago lanceolata L., ribgrass; English plantain. Fairly common weed, lawns and new clearings. DEVILS (*J* 6686). EAGLE (*K* 13077-b, UWL). IRONWOOD (*J* 6290). MADELINE (*J* 8723). MAINLAND (*K* 8252, UWL). MANITOU (*J* 9513). OUTER (*J* 6012). RASPBERRY (*J* 8969). ROCKY (*J* 9710). SAND (*J* 9285). SOUTH TWIN (Heidel s.n., UWL). STOCKTON (*J* 8439).

\*Plantago major L., common plantain. Common weed, clearings and trails. BASS-WOOD (J 8141). DEVILS (J 6657). EAGLE (J 7850). IRONWOOD (J 6252). LONG (J 8635). MADELINE (J 8095). MAINLAND (K 8937, UWL). MANITOU (J 7250). MICHIGAN (J 7389). OAK (J 8406). OTTER (J 6415). OUTER (J 6062). RASP-BERRY (K 14019, UWL). ROCKY (J 8891). SAND (J 8191). SOUTH TWIN (J 8850). STOCKTON (J 8435).

# POLEMONIACEAE (Phlox Family)

- \*Phlox paniculata L., perennial or garden phlox. BASSWOOD (spreading from cultivation, Rudd Farm; Middleton s.n., 30 Jul 1980, APIS).
- Phlox pilosa L., prairie phlox. MADELINE (S Shore Rd. ditch, 1.6 km SE of Chebomnicon Bay, 10 Jun 1965, McCown 33, WIS).
- \*Phlox subulata L., moss phlox. DEVILS (spreading from cultivation in brushland N of light station; J 6619).

### POLYGONACEAE (Buckwheat Family)

- Polygonella articulata (L.) Meissner, jointweed. Occasional, sand spit dunes. LONG (Tans 1903, MIL). MADELINE (Houghton s.n., 10 Aug 1832, MICH). MICHIGAN (sight record: J. Van Stappen and T. Doolittle, 1990). OUTER (Fraundorf s.n., 2 Sep 1978, UWSP). ROCKY (J 6785). STOCKTON (Lane 3307, NCAW).
- Polygonum achoreum Blake. Rare. MADELINE (weed at airport; J 8765). MAIN-LAND (K 8958, UWL).
- Polygonum amphibium L., water-smartweed. Uncommon, ponds. MADELINE (new marina; J 9412). OUTER (beaver flowage; Fraundorf s.n., 6 Sep 1978, UWSP). STOCKTON (Quarry Bay slough; J 9171).
- \*Polygonum aviculare L., knotweed. Occasional weed. EAGLE (sandstone ledges; *J* 7800). MADELINE (*J* 9391). MAINLAND (*K* 8955, UWL). RASPBERRY (*J* 9925). SAND (*J* 9791).
- Polygonum cilinode Michaux, fringed bindweed; fringed false buckwheat. Common on shores, especially on clay bluffs; occasional, inland clearings. BASSWOOD (J 9353).
  BEAR (J 7107). CAT (Team 1, WIS). DEVILS (J 6671). GULL (J 7883). IRONWOOD (J 6288). LONG (K 8782, UWL). MADELINE (Freckmann 12897, UWSP).
  MAINLAND (K 8547, UWL). MANITOU (J 7248). MICHIGAN (Team 6, UWL).
  NORTH TWIN (J 6546). OAK (Jones s.n., WIS). OTTER (J 6423). OUTER (Lane 2164, WIS). RASPBERRY (J 6895). ROCKY (J 6819). SAND (J 8241). SOUTH TWIN (Heidel s.n., UWL). STOCKTON (Beals AP-34, WIS). YORK (K 11921, UWL).
- \*Polygonum convolvulus L., black bindweed. Occasional lawn weed. GULL (sight record: W. Tans, 1971; not relocated, 1991). MADELINE (J 9895). OAK (J 9444). ROCKY (J 9706). STOCKTON (Verch & Riva s.n., 8 Jun 1974, NCAW).
- \*Polygonum cuspidatum Siebold & Zucc., Japanese knotweed. RASPBERRY (persisting and aggressively spreading from cultivation around lighthouse; *Dobie 196*, *J* 8962, WIS).
- Polygonum hydropiper L., water-pepper; common smartweed. Common, wetland edges and wet openings. BASSWOOD (J 9331). BEAR (J 9094). EAGLE (J 7834). GULL (uncommon; J 7873). HERMIT (J 9469). LONG (Gull s.n., 9 Sep 1989, APIS). MADELINE (J 9361). MAINLAND (Gallagher s.n., 17 Sep 1988, ISC). OAK (Cottam & Vogl 666, WIS). OTTER (Bowers 11694). OUTER (J 9598). RASP-BERRY (J 6901). ROCKY (K 11814, UWL). SAND (J 8536). SOUTH TWIN (Heidel s.n., 21 Aug 1977, UWL). YORK (J 7689).
- Polygonum lapathifolium L., pale smartweed. Occasional, wet disturbed edges. LONG (J 8631). MADELINE (Kron Road, J 9376, Goessl 7947, WIS). SAND (J 9790). STOCKTON (J 9868).
- Polygonum pensylvanicum L., pinkweed. Occasional, wet edges. MADELINE (marina; J 9804). SAND (J 9794). STOCKTON (Presque Isle dock; J 9560).
- \*Polygonum persicaria L., lady's-thumb. Occasional weed. LONG (*J 6940*). MANITOU (*Lane 2596*, NCAW). RASPBERRY (*J 9939*).
- Polygonum punctatum Elliott, water-smartweed. Occasional, wetlands. LONG (Cheney 5382, WIS). MADELINE (Chebomnicon Bay, J 9400). MAINLAND (K 9064, UWL). STOCKTON (Lane 2530, WIS).
- Polygonum ramosissimum Michaux, bushy knotweed. Uncommon weed. MADELINE (La Pointe; J 8764). MAINLAND (K 8959, UWL). SAND (East Bay; J 9304).
- Polygonum sagittatum L., arrow-leaved tearthumb. Occasional, alder thickets and edges of lagoons and beaver flowages. LONG (J 7936). MADELINE (Cheney 5716,

- WIS). MAINLAND (K 9070, UWL). MANITOU (Lane 2597, NCAW). OAK (K 11784, UWL). SAND (J 8659). STOCKTON (J 9173.5).
- *Polygonum scandens* L., climbing false-buckwheat. Uncommon. LONG (moist sand at filled-in breach; *J 8606*). MICHIGAN (clay bluffs near lighthouse; *J 9546*).
- \*Rheum rhabarbarum L., rhubarb. Uncommon relict of cultivation. BASSWOOD (sight record: J, McCloud Farm, 1992). RASPBERRY (sight record: R. Dobie, 1976). ROCKY (sight record: J, near dock, 1992).
- \*Rumex acetosella L., sheep-sorrel. Common, coasts and clearings. BASSWOOD (K 8405, UWL). BEAR (J 7110). CAT (J 7986). DEVILS (J 6696). EAGLE (J 7790). GULL (fairly common; J 7889). HERMIT (J 7558). IRONWOOD (J 6281). LONG (K 7384). MADELINE (K 10442, UWL). MAINLAND (K 8257B, UWL). MANITOU (J 7167). MICHIGAN (J 7380). OAK (Beals AP-220, WIS). OTTER (J 64344). OUTER (K 10887, UWL). RASPBERRY (Dobie s.n., APIS). ROCKY (Cochrane & Cochrane 9304, WIS). SAND (J 8218). SOUTH TWIN (Middleton s.n., 8 Aug 1980, APIS). STOCKTON (Beals AP-53, WIS). YORK (sight records: R. Dobie, J).
- \*Rumex crispus L., curled dock. Common, clearings and clay bluffs. BASSWOOD (Lane 2399, WIS). BEAR (J 9113). DEVILS (J 6649). HERMIT (J 9487). IRONWOOD (J 9211). LONG (J 8588). MADELINE (J 8082). MAINLAND (K 8598, UWL). MANITOU (J 7157). MICHIGAN (J 7427). OAK (Lane 2214, NCAW). OUTER (J 7491). RASPBERRY (Dobie 58, WIS). ROCKY (J 9709). SAND (J 8249). SOUTH TWIN (J 6846). STOCKTON (Fraundorf s.n., 14 Aug 1979, UWSP).
- \*Rumex obtusifolius L., bitter dock. Fairly common, trailsides and wet edges. BASS-WOOD (J 8185). DEVILS (J 6640). GULL (J 7872). MADELINE (Goessl 7964, MIL). MAINLAND (K 8554, UWL). MANITOU (J 7123). MICHIGAN (J 7375). OAK (Jones s.n., WIS). OTTER (J 6408). ROCKY (Clements R-84, UWL). SAND (J 8228). SOUTH TWIN (J 8848). STOCKTON (Verch & Riva s.n., 24 Jul 1973, NCAW).
- Rumex orbiculatus A. Gray, great water dock. Occasional, marshes, beaver flowages, and alder thickets. BEAR (sand spit; J 9097). LONG (alder thicket; K 9128, UWL).
  MADELINE (J 9414). MAINLAND (Sand River bog; Brandt s.n., 17 Sep 1988, APIS). RASPBERRY (E tip alders; J 9914). STOCKTON (Quarry Bay slough; J 9561).

### PORTULACACEAE (Purslane Family)

- Claytonia caroliniana Michaux, Carolina spring-beauty. Uncommon, rich upland woods. OUTER (J 6085). SAND (W tip and lighthouse point; J 8199). STOCKTON (Verch & Riva s.n., 1 Jun 1974, NCAW).
- \*Portulaca oleracea L., common purslane. Rare garden weed. RASPBERRY (J 6866).

## PRIMULACEAE (Primrose Family)

- Lysimachia ciliata L., fringed loosestrife. Occasional, trails and old clearings. LONG (sand cut; J 8388). MADELINE (J 9407). MAINLAND (K 8532, UWL). OTTER (J 8873). OUTER (trail ca. 1 km N of sand spit; J 7500). ROCKY (Cochrane & Cochrane 9359, WIS). SAND (J 8641). STOCKTON (Verch & Riva s.n., 9 Aug 1973, NCAW).
- Lysimachia terrestris (L.) Britton, Stearns, & Pogg., yellow or swamp loosestrife. Fairly common, beaver meadows, alder thickets, and bog edges. BEAR (J 6948). CAT (J 9216). LONG (K 8790, WIS). MADELINE (Goessl 7980, MIL). MAINLAND (K 8599, UWL). MANITOU (J 9068). MICHIGAN (J 7370). OTTER (J 9763). OUTER (Lane 2495, WIS). RASPBERRY (J 6934). ROCKY (J 6814). SAND (Toole s.n., 25 Jul 1910, WIS). SOUTH TWIN (J 9777). STOCKTON (Taylor 3591, MIL). YORK (J 8799).
- Lysimachia thyrsiflora L., tufted loosestrife. Occasional, beaver flowages, alder thickets, and wet, sandy shores. BEAR (J 9086). HERMIT (J 9464). LONG (Kimber s.n., 9 Sep 1989, ISC). MICHIGAN (Lane 2791, WIS). RASPBERRY (J 6905). ROCKY (S slough; J 8905). STOCKTON (J 8483).
- Primula mistassinica Michaux, bird's-eye primrose. Locally common, moist sandstone bluffs and ledges. DEVILS (common; Tans 1607, WIS). MAINLAND (abundant,

Squaw Bay cliffs [Sec. 7-9 and 18 of T51N, R5W], *Cheney 6452*, WIS. common, W side of Sand Point [Sec. 34 of T52N, R5W], *J 8572*). SAND (common, E side of Lighthouse Point; *J 8186*). STOCKTON (local, SE Presque Isle Point; *J 7910*). YORK (common, N coast rocks; *J 7695*).

Trientalis borealis Raf., starflower. Abundant, woods. BASSWOOD (K 8284, UWL). BEAR (J 7082). CAT (J 6146). DEVILS (J 6726). EAGLE (J 7819). HERMIT (Team 5, UWL). IRONWOOD (J 6249). LONG (J 7952). MADELINE (Beals AP-186, WIS). MANITOU (K 13637, UWL). MICHIGAN (K 13674, UWL). NORTH TWIN (J 6573). OAK (Jones s.n., WIS). OTTER (J 6405). OUTER (Team 5, WIS). RASPBERRY (K 11266, WIS). ROCKY (Team 2, UWL). SAND (Cheney 6191, MIL). SOUTH TWIN (Team 4, UWL). STOCKTON (Beals AP-11, WIS). YORK (K 11531, UWL).

### PYROLACEAE (Wintergreen Family)

Chimaphila umbellata (L.) Barton, pipsissewa. Occasional, pine woods on sand spits. BEAR (J 8010). CAT (J 6096). LONG (J 7949). MADELINE (Goessl 7928, WIS). MAINLAND (Cheney 6308, WIS). MICHIGAN (J 7273). OAK (Jones s.n., WIS). OUTER (J 6080). RASPBERRY (J 6856). STOCKTON (Perkins s.n., 23 Jul 1976, APIS).

Moneses uniflora (L.) A. Gray, one-flowered pyrola. Occasional, pine woods, coniferous swamp edges, and steep, forested banks. BEAR (J 9114). CAT (J 9280). DEVILS (J 6742). HERMIT (Lane 2121, WIS). IRONWOOD (J 9189). MAINLAND (K 8643, UWL). MANITOU (J 7993). MICHIGAN (J 7420). OAK (Hildebrandt 146, APIS). OTTER (J 6334). OUTER (Fraundorf s.n., 16 Jul 1978, UWSP). RASPBERRY (J 6881). ROCKY (J 6782). SAND (J 6036). SOUTH TWIN (Team 3, WIS). STOCKTON (Lane 2757, WIS). YORK (J 9956).

Monotropa hypopithys L., pinesap. Occasional, woods. BASSWOOD (K 8680, UWL). BEAR (J 7009). DEVILS (J 6680). HERMIT (Team 3, UWL). LONG (K 9139, UWL). MADELINE (Cheney 5717, MIL). MAINLAND (K 8582, UWL). MANITOU (Team 4, UWL). MICHIGAN (J 7333). OAK (Goessl 7918, WIS). OTTER (J 9766). ROCKY (J 7994). STOCKTON (Verch & Riva s.n., 23 Jul 1973, NCAW).

Monotropa uniflora L., Indian-pipe. Common, woods. BASSWOOD (Cheney 5785, WIS). BEAR (J 9725). DEVILS (Nee & Peet 1841, WIS). HERMIT (Team 6, UWL). LONG (J 7957). MADELINE (Beals AP-108, WIS). MAINLAND (K 8585, UWL). MANITOU (Team 1, UWL). MICHIGAN (J 7292). NORTH TWIN (sight record: W. Tans & R. H. Read, 1977). OAK (Lane 2247, WIS). OTTER (J 9765). OUTER (J 7494). RASPBERRY (J 8981). ROCKY (Dobie s.n., WIS). SAND (Cheney 6160, WIS). SOUTH TWIN (Heidel s.n., 9 Aug 1977, UWL). STOCKTON (Taylor 3639, MIL).

Pyrola asarifolia Michaux, pink pyrola. Occasional, woods and clearings. BASS-WOOD (Rudd Farm; Middleton s.n., 30 Jul 1980; APIS). DEVILS (N tip; J 6698). LONG (K 7554, WIS). MICHIGAN (Toole s.n., 12 Jul 1910, WIS). OAK (Middleton s.n., 11 Jun 1980, APIS). OUTER (J 6066). STOCKTON (Trout Point; Clements 346, APIS). YORK (J 8805).

Pyrola chlorantha Swartz, green-flowered pyrola. Uncommon, woods. MADELINE (Goessl 7941, WIS). MAINLAND (K 8581, UWL). OAK (J 7753). OUTER (K 10966, UWL). RASPBERRY (J 6853).

Pyrola elliptica Nutt., shinleaf. Common, woods and clearings. BASSWOOD (K 8714, UWL). BEAR (J 7056). CAT (J 6132). DEVILS (J 6603). HERMIT (Team 5, UWL). IRONWOOD (J 6213). LONG (K 8770, UWL). MADELINE (Goessl 8051, MIL). MAINLAND (K 8544, UWL). MANITOU (J 9034). MICHIGAN (J 7328). NORTH TWIN (J 9674). OAK (Middleton s.n., APIS). OTTER (J 6430). OUTER (K 10946, UWL). RASPBERRY (J 8031). ROCKY (Dobie 134, WIS). SAND (J 8232). SOUTH TWIN (Heidel s.n., 4 Aug 1977, UWL). STOCKTON (Goessl 7945, MIL). YORK (J 8804).

Pyrola rotundifolia L., round-leaved pyrola. Rare, woods; not noted in present study. LONG (Cheney 5337, WIS). MADELINE (Bobb 170, WIS).

Pyrola secunda L., one-sided pyrola. Occasional in woods, especially near bogs and coasts. BASSWOOD (K 8736-a, UWL). DEVILS (Collingson D-119, UWL). HER-MIT (J 8068). IRONWOOD (J 9205). MADELINE (J 8705). MAINLAND (Voss 10048, WIS). MICHIGAN (Team X, Plot 16, UWL). OAK (Hildebrandt 148, APIS). OUTER (Fraundorf s.n., 10 Jul 1978, UWSP). RASPBERRY (J 6852). ROCKY (J 6793). SOUTH TWIN (Heidel s.n., 21 Aug 1977, UWL). STOCKTON (J 9165).

## RANUNCULACEAE (Crowfoot Family)

Actaea pachypoda Elliott, white baneberry. Occasional, woods. BASSWOOD (J 9345). HERMIT (Team 3, UWL). MAINLAND (K 8352, UWL). MANITOU (J 9035). OAK (fairly common; Jones s.n., WIS). RASPBERRY (J 8949). STOCKTON (K 10824, UWL).

Actaea rubra (Aiton) Willd., red baneberry. Fairly common, woods. BASSWOOD (K 8263-a, UWL). BEAR (J 6979). DEVILS (J 6710). HERMIT (J 7639). LONG (Cheney 5320, WIS). MADELINE (Cheney 5657, WIS). MAINLAND (K 8561, UWL). MANITOU (J 9038). MICHIGAN (J 7302). OAK (J 7784). OTTER (J 6337). OUTER (J 7490). RASPBERRY (J 6872). SAND (sight record: J). STOCKTON (Verch & Riva s.n., 28 Jun 1973, NCAW).

Anemone canadensis L., Canada anemone. Occasional, clearings and shores. BASS-WOOD (K 8466, UWL). LONG (J 7929). MADELINE (Goessl 7976, MIL). MAIN-LAND (Cheney 6355, WIS). MANITOU (NW clearing; Frostman 676, APIS). OUTER (Fraundorf s.n., 2 Jul 1978, UWSP). SAND (sight record: J). STOCKTON (Clements 341, APIS).

Anemone cylindrica A. Gray, thimbleweed. Rare. OAK (sand spit dune edge; J 8411). Anemone quinquefolia L., wood anemone. Common, woods. BASSWOOD (K 8262, UWL). CAT (J 6100). HERMIT (J 7614). MADELINE (Goessl 7898, MIL). MAINLAND (K 8138, UWL). MANITOU (J 7170). OAK (J 7725). OTTER (J 6441). OUTER (J 6048). RASPBERRY (J 6871). ROCKY (Dobie 119, WIS). SAND (Cheney 6192, WIS). SOUTH TWIN (J 8937). STOCKTON (Falck s.n., 25 May 1990, UWSP). YORK (sight record: J).

\*Aquilegia vulgaris L., garden columbine. MICHIGAN (cultivated and slightly spreading at lighthouse; J 9556).

Caltha palustris L., marsh-marigold. Fairly common, creek bottoms and outlets, and beaver ponds. BASSWOOD (J 8180). BEAR (J 9109). HERMIT (J 7574). LONG (J 8375). MADELINE (J 8097). MAINLAND (K 8144, UWL). MANITOU (J 7218). MICHIGAN (J 7318). OAK (J 7987). OTTER (J 6339). OUTER (sight record: J, 1990). RASPBERRY (K 11230, UWL). ROCKY (J 8926). SAND (Middleton s.n., 27 Apr 1980, APIS). SOUTH TWIN (Dorney s.n., 2 Jun 1947, WIS). STOCKTON (K 13735, UWL). YORK (J 9948).

Clematis virginiana L., virgin's bower. Uncommon, coastal thickets. MAINLAND (Saxine Creek; J 8582). SAND (East Bay; J 8295). STOCKTON (Anderson Bay; J 8499). YORK (sand spit; J 8819).

Coptis groenlandica (Oeder) Fern., goldthread. Fairly common, moist coniferous or mixed woods. BEAR (J 6951). CAT (J 6094). DEVILS (Nee & Peet 1836, WIS). HERMIT (J 7697). IRONWOOD (J 6304). MADELINE (J 8101). MAINLAND (K 8218, UWL). MANITOU (J 7240). MICHIGAN (J 7371). OAK (Hildebrandt 240, APIS). OTTER (J 9758). OUTER (K 13453, UWL). RASPBERRY (J 8958). ROCKY (J 6762). SAND (Massopeist s.n., Jul 1980, UWSP). SOUTH TWIN (Team 3, UWL). STOCKTON (Taylor 3645, MIL). YORK (K 11529, UWL).

Hepatica americana (DC.) Ker Gawler, round-lobed hepatica or liverleaf. Rare, woods. OAK (near summit and in N ravines; K 11980, UWL). OUTER (sight record: R. Anderson).

Ranunculus abortivus L., kidneyleaf buttercup. Occasional, upland woods and trails.

BASSWOOD (J 8151). MADELINE (J 8709). MAINLAND (K 8255, UWL). MICHIGAN (K 13665, UWL). OAK (J 8407). RASPBERRY (J 8947). SAND (J 8204).

STOCKTON (J 8429).

\*Ranunculus acris L., common or tall buttercup. Abundant, clearings and trails. BASS-

WOOD (*K* 8296, UWL). BEAR (*J* 7047). CAT (*K* 12039, UWL). DEVILS (*J* 6704). GULL (*Lane* 2790, WIS: not noted, 1991). HERMIT (*J* 7542). IRONWOOD (*J* 6291). MADELINE (*McCown* 14, WIS). MAINLAND (*K* 8325, UWL). MANITOU (*J* 7130). MICHIGAN (*J* 7396). NORTH TWIN (*J* 6512). OAK (*Beals AP-102*, WIS). OTTER (*J* 6407). OUTER (*K* 13469, WIS). RASPBERRY (*Dobie* 23, WIS). ROCKY (*Team* 6, UWL). SAND (*Cheney* 6182, WIS). SOUTH TWIN (*Cochrane* & *Cochrane* 9211, WIS). STOCKTON (*Falck s.n.*, 16 Jun 1990, UWSP). YORK (sight record: R. Dobie, 1976).

Ranunculus hispidus Michaux, swamp buttercup. Fairly common, beaver meadows, shores, and ravine mouths. BEAR (J 8181). DEVILS (J 6662). HERMIT (J 7564). LONG (J 8611). MAINLAND (K 8324, UWL). MICHIGAN (J 7312). NORTH TWIN (J 6519). OAK (J 7779). OUTER (Fraundorf s.n., 10 Aug 1978, UWSP). RASPBERRY (J 6904). ROCKY (J 8914). SAND (Cheney 6219, WIS). STOCKTON (Falck s.n., 20 Jun 1990, UWSP). YORK (sight record: R. Dobie).

Ranunculus longirostris Godron, white water-crowfoot. Rare. MADELINE (old

marina pond, locally common; J 9812).

Ranunculus pensylvanicus L.f., bristly buttercup. Fairly common, swampy woods. BASSWOOD (K 8455-a, UWL). BEAR (J 7001). DEVILS (K 11828, UWL). HER-MIT (J 9463). IRONWOOD (J 9183). LONG (Cheney 5373, WIS). MADELINE (J 9364). OUTER (J 9614). RASPBERRY (J 9902). ROCKY (J 9714). SAND (J 9309). STOCKTON (Verch & Riva s.n., 28 Jun 1973, NCAW).

Ranunculus recurvatus Poiret, hooked buttercup. Fairly common, ravine bottoms and wetland edges. BEAR (*J 9106*). IRONWOOD (*J 9187*). MADELINE (*J 8110*). MAINLAND (*K 8249*, UWL). MANITOU (*J 9037*). MICHIGAN (*K 13654*, UWL). OAK (*Fassett et al. 20042*, WIS). OUTER (*J 6059*). RASPBERRY (*J 6884*). STOCKTON (*J 9145*).

Ranunculus reptans L., creeping spearwort. Uncommon, sandy pond edges. LONG

(Cheney 5406, WIS). OUTER (N part of sand spit lagoon; J 6016).

Thalictrum dasycarpum Fischer & Avé-Lall., tall meadow-rue. Occasional, shaded dune margins and wetland edges. BASSWOOD (K 8536, UWL). BEAR (J 7090). CAT (J 6160). HERMIT (J 7563). IRONWOOD (J 6257). LONG (Cheney 5328, WIS). MAINLAND (K 8536, UWL). MANITOU (J 7165). NORTH TWIN (J 6529). OAK (Beals AP-101, WIS). OTTER (J 6463). OUTER (J 7475). RASPBERRY (J 6878). ROCKY (Cochrane & Cochrane 9346, WIS). SOUTH TWIN (sand spit; Heidel s.n., 9 Aug 1977, UWL). STOCKTON (Clements 342, APIS). YORK (J 7680).

Thalictrum dioicum L., early meadow-rue. Occasional, moist woods and thickets. DEVILS (J 6737). IRONWOOD (K 12723, UWL). MADELINE (J 8107). MANITOU (J 9053). SAND (J 8291). STOCKTON (J 8504).

## RHAMNACEAE (Buckthorn Family)

\*Rhamnus cathartica L., common buckthorn. MADELINE (spreading in ditches near La Pointe; J 8760).

### ROSACEAE (Rose Family)

Agrimonia striata Michaux, agrimony. Fairly common, clearings and disturbed woods. BASSWOOD (J 8139). HERMIT (W cabin and quarry; J 7541). IRONWOOD (sand spit; J 6242). MADELINE (Beals AP-134, WIS). MAINLAND (K 8882, UWL). MANITOU (J 7193). MICHIGAN (J 7331). RASPBERRY (J 6855). STOCKTON (Lane 2526, WIS).

Amelanchier bartramiana (Tausch) M. Roemer, mountain or Bartram's juneberry. Occasional, coastal thickets ("krumholtz"), lighthouse clearing edges, and pine woods. DEVILS (N tip; Taylor 3674, MIL). LONG (Cheney 5351, WIS). MADELINE (Cheney 5649, WIS). MAINLAND (sandy beach ridge, Little Sand Bay; K 8190, UWL). NORTH TWIN (N tip; J 6516). OUTER (Austad Bay and sand spit; Jackson & Sheldon 202, WIS). SAND (lighthouse; J 8190). STOCKTON (Presque Isle pine woods; Taylor 3644, MIL).

Amelanchier humilis Wieg., low juneberry. Occasional, thickets and clearings. BASS-WOOD (Team 1, 2 Jul 1975, UWL). HERMIT (Team 6, 16 Jul 1975, UWL). IRON-

WOOD (Clements 41, UWL). LONG (Cheney 5327, WIS). MADELINE (Bobb 180, WIS). MICHIGAN (K 13703, UWL). ROCKY (J 6787). SAND (Justice Bay; J 8233).

Amelanchier interior Nielsen. Occasional, coastal clearings and thickets. DEVILS (J 6659). GULL (J 7894). HERMIT (J 7604). LONG (K 7390, UWL). MAINLAND (K 8188, UWL). NORTH TWIN (K 13522, UWL). OAK (Hildebrandt 355, APIS). OTTER (J 6429). RASPBERRY (J 6876). SOUTH TWIN (J 6841). STOCKTON (Julian Bay; K 13755, UWL). YORK (J 8814).

Amelanchier laevis Wieg., smooth juneberry. Common, clearings and coastal clay bluffs. BASSWOOD (K 8301, UWL). BEAR (J 9111). CAT (J 6163). HERMIT (J 7528). IRONWOOD (J 6282). LONG (K 7391, WIS). MANITOU (J 9065). MICHIGAN (J 7357). OAK (Beals AP-72, WIS). OTTER (J 6310). OUTER (J 6054). ROCKY (Middleton s.n., 1 Jul 1982, APIS). SAND (J 8321). STOCKTON (Taylor 3606, MIL).

Amelanchier sanguinea (Pursh) DC. Fairly common, clearings and coastal clay bluffs.
BASSWOOD (J 8135). GULL (K 13924, UWL). MADELINE (Kruschke 49-160, MIL). NORTH TWIN (Read 1602, WIS). OUTER (K 13476, UWL). SAND (J 8259).

Aronia melanocarpa (Michaux) Elliott, black chokeberry. Rare. LONG (boggy swales near E end of island; Lane 2102, NCAW; J 8377).

Crataegus chrysocarpa Ashe. Occasional. MADELINE (2.4 km S of La Pointe; Kruschke 48-146, MIL). OAK (sandscape clearing; J 8411). SAND (South Road; J 8307).

\*Crataegus douglasii Lindley, black hawthorn. Rare; apparently introduced near dwellings for the juicy black fruits. Emil Kruschke's 1964 collection labels indicate (based on a local resident's information) that the Madeline Island specimens were planted "by an Irishman about 40 years ago" to commemorate his son's death, and that the site was known locally as "Black Haw Cemetery." MADELINE (Chebomnicon Bay between Co. H and shore, NE1/4 of NE1/4, Sec. 27 of T50N, R3W, 0.3 km N of Moore's Beach resort; Kruschke 64-25, MIL. 0.4 km E of Moore's Beach resort, Kruschke 64-26, MIL; S of Moore's Beach resort, SW1/4 of NE1/4, Sec. 27; Fuller 61-252). RASPBERRY (8 m tall tree, 50 m SE of lighthouse; J 9900: J 8307 from woods N of lighthouse may also be this species).

Crataegus laurentiana Sarg. Locally common, MADELINE (2.4 km S of La Pointe; Kruschke 49-147, MIL).

Crataegus macracantha Lodd. Rare. MADELINE (La Pointe; Kruschke 65-5, MIL). Crataegus punctata Jacq. Rare, old clearings. BASSWOOD (K 8719, UWL).

Crataegus roanensis Ashe (including C. macrosperma Ashe var. roanensis (Ashe) E. J. Palmer). Rare. MADELINE (0.8 km NE of La Pointe; Kruschke 49–149, MIL).

Fragaria vesca L., wood strawberry. Occasional, rocky shores and clearings. CAT (J 9235). DEVILS (Taylor 3691, MIL). IRONWOOD (J 9201). MAINLAND (K 8230, UWL). MANITOU (J 9049). NORTH TWIN (J 6570). OUTER (Austad Bay; J 9641). ROCKY (Clements R-50, UWL).

Fragaria virginiana Duchesne, wild strawberry. Common, coasts, clearings, and young woods. BASSWOOD (K 8304). BEAR (J 7040). CAT (Team 6, UWL). DEVILS (Beals s.n., WIS). HERMIT (Lane 2139, NCAW). IRONWOOD (J 6271). LONG (K 7380, WIS). MADELINE (Dorney s.n., 30 May 1947, WIS). MANITOU (J 7149). MICHIGAN (J 7344). NORTH TWIN (J 6518). OAK (Hildebrandt 255, APIS). OTTER (J 6386). OUTER (Fraundorf s.n., 4 Jul 1978, UWSP). RASPBERRY (Dobie 18, WIS). ROCKY (J 8925). SAND (Cheney 6181, WIS). SOUTH TWIN (Cochrane & Cochrane 9313, WIS). STOCKTON (J 8442). YORK (K 11418, UWL).

Geum aleppicum Jacq., yellow avens. Fairly common, clearings and trailsides. BASS-WOOD (Middleton s.n., 30 Jul 1980, APIS). BEAR (J 9722). DEVILS (J 6619). EAGLE (J 7796). HERMIT (J 7537). IRONWOOD (J 9209). MADELINE (J 8724). MANITOU (J 7143). MICHIGAN (J 7392). OAK (Hildebrandt 228, APIS). OTTER (J 6354). OUTER (J 9626). RASPBERRY (J 6867). ROCKY (J 8882). SAND (J 8269). SOUTH TWIN (J 6836). STOCKTON (Fraundorf s.n., 14 Aug 1979, UWSP). YORK (J 8822).

Geum canadense Jacq., white avens. Occasional, clearings. BASSWOOD (K s.n.,

UWL). HERMIT (*Team 6*, UWL). IRONWOOD (*J 9206*). MADELINE (*J 9385*). OTTER (*J 6353*). STOCKTON (*K 10805*, UWL).

Physocarpus opulifolius (L.) Maxim., ninebark. Fairly common, shores. BASSWOOD (K 8721, UWL). BEAR (J 6960). CAT (J 6109). DEVILS (J 6738). MADELINE (J 9883). MANITOU (J 7221). MICHIGAN (Middleton s.n., 12 Jul 1982, APIS). OAK (Beals AP-94, WIS). OTTER (J 6389). OUTER (Tans s.n., 23 Aug 1971, WIS). RASPBERRY (sight record: J). ROCKY (J 6810). SAND (J 8187). STOCKTON (Cochrane & Cochrane 9251, WIS). YORK (J 7686).

Potentilla anserina L., silverweed. Rare. OUTER (sandy shore, Lane 2163, in 1955, NCAW: not noted in present study).

\*Potentilla argentea L., silvery cinquefoil. Rare weed. MADELINE (Amnicon Bay; J 8102).

Potentilla norvegica L., rough cinquefoil. Common, clearings, trailsides, and clay bluffs. BASSWOOD (Lane 2411, WIS). BEAR (J 7022). CAT (J 9260). DEVILS (J 6621). EAGLE (J 7863). GULL (J 7875). HERMIT (J 9461). IRONWOOD (J 9210). LONG (J 7938). MADELINE (J 8098). MAINLAND (K 8391, UWL). MANITOU (J 7223). MICHIGAN (J 7395). OAK (Hildebrandt 245, APIS). OTTER (J 8881). OUTER (K 10932, UWL). RASPBERRY (J 8971). ROCKY (J 6766). SAND (J 8655). SOUTH TWIN (J 6826). STOCKTON (Taylor 3616, MIL). YORK (J 7666).

Potentilla palustris L., marsh cinquefoil. Fairly common, beaver flowages, marshes, and bogs; occasional, rock pools. BEAR (J 9095). CAT (J 9233). HERMIT (NW ravine; J 7575). LONG (K 7547, WIS). MADELINE (Grether 7215, WIS). MAINLAND (K 8594, UWL). MICHIGAN (J 7454). OAK (J 8398). OUTER (K 10930, UWL). RASPBERRY (J 6937). ROCKY (Dobie 148, APIS). SAND (J 8316). SOUTH TWIN (J 9021). STOCKTON (Coffin 384, WIS).

\*Potentilla recta L., rough-fruited or sulfur cinquefoil. Occasional, clearings and old fields. BEAR (W coast clearing; J 7027). IRONWOOD (J 7989). MADELINE (J 9387). MANITOU (J 7192). ROCKY (J 9711). SOUTH TWIN (J 8851).

Potentilla simplex Michaux, old-field cinquefoil. Occasional, clearings and old fields. BASSWOOD (J 8162). BEAR (J 7990). HERMIT (J 9482). MADELINE (J 9830). OUTER (J 9595). RASPBERRY (sight record: J). STOCKTON (J 7902).

Potentilla tridentata Aiton, three-toothed cinquefoil. Occasional, sand spits, rocky coasts, and lighthouse clearings. BASSWOOD (S tip; Team 5, UWL). CAT (E coast rocks; J 9241). DEVILS (Beals s.n., WIS). LONG (K 7492). MADELINE (Goessl 8029, WIS). MAINLAND (Cheney 6361, WIS). NORTH TWIN (J 6548). OAK (sight record: J. Hildebrandt). OUTER (common, E coast; Cottam & Vogl 617, WIS). RASPBERRY (J 6943). ROCKY (sight record: R. Dobie). SOUTH TWIN (J 6487). STOCKTON (Lane 2425, WIS). YORK (J 7683).

Prunus americana Marshall, wild plum. Occasional, clearings and old fields. BASS-WOOD (McCloud Farm; J 8334). MADELINE (Kruschke 51-39, MIL). MANITOU (fish camp; J 9075). MICHIGAN (old railhead; J 9516). SAND (West Bay; J 8313).

Prunus pensylvanica L.f., pin cherry. Occasional, young woods and coastal bluffs. BASSWOOD (J 8173). BEAR (J 7043). CAT (J 6162). DEVILS (Beals s.n., WIS). GULL (rare; J 7878). HERMIT (J 9492). IRONWOOD (J 6277). LONG (K 7371, WIS). MADELINE (Beals AP-125, WIS). MAINLAND (K 8245, UWL). MANITOU (J 7126). MICHIGAN (J 7342). NORTH TWIN (common, Lane 2180, WIS). OAK (Escoll 64, MIL). OTTER (J 6340). OUTER (common, N part; Lane 2515, WIS). RASPBERRY (J 6875). ROCKY (Tans 1587, MIL). SAND (Cheney 6185, WIS). SOUTH TWIN (Team 3, WIS). STOCKTON (K 13729, UWL). YORK (K 11920, UWL).

Prunus pumila L., sand cherry. Common, sand spit dunes; rare, rock pools. A local common name: "butter plum." (Madeline Island, Lapham s.n., Sep 1858, WIS).
BEAR (K 11095, UWL). CAT (J 6168). LONG (K 8161, WIS). MADELINE (Grether 7223, WIS). MAINLAND (Cheney 6304, WIS). MICHIGAN (K 11755, UWL).
NORTH TWIN (E coast rocks; J 6537). OAK (Fassett 19940, WIS). OUTER (Lane 2719, WIS). RASPBERRY (J 6862). ROCKY (J 6786). SOUTH TWIN (J 6483).
STOCKTON (Middleton s.n., 29 Aug 1979, APIS).

- Prunus virginiana L., choke cherry. Occasional, rich upland woods. BEAR (near S tip; J 7010). EAGLE (J 7799). LONG (J 8374). MADELINE (J 8121). OAK (J 7758). OTTER (J 6380). OUTER (sight records: R. B. Brander, J). ROCKY (J 6770). SAND (J 8294). STOCKTON (J 8459).
- \*Pyrus malus L., apple. Persisting from cultivation near old clearings. BASSWOOD (Rudd Farm; Middleton s.n., 30 Jul 1980, APIS). CAT (E coast log landing; J 9232). DEVILS (J 9001). HERMIT (quarry; Team 6, UWL). LONG (protected beach, bayshore side; K 9125, UWL). MADELINE (sight record: J). MANITOU (sight record: J, fish camp). MICHIGAN (J 7257). OUTER (J 9583). SAND (J 8305).
- Rosa acicularis Lindley, bristly rose. Occasional, clearings and sand spits. CAT (J 6171). DEVILS (J 6705). EAGLE (J 7815). IRONWOOD (Collins 218, UWL). LONG (sight record: W. Tans). MADELINE (Cheney 5691, WIS). OAK (Lane 2215, NCAW). OUTER (Team 3, 11 Aug 1975, UWL). RASPBERRY (K 11206, UWL).
- Rosa blanda Aiton, smooth rose. Fairly common, sand spits and clearings. BASS-WOOD (K 8716, UWL). BEAR (J 9746). GULL ("forming 4 ft. thickets" in 1955; Lane 2786, NCAW: not noted in 1991). HERMIT (J 7533). LONG (Cheney 5313, WIS). MADELINE (Goessl 8028, MIL). MAINLAND (K 8916, UWL). MANITOU (J 7139). MICHIGAN (K 11756, UWL). OAK (Beals AP-89, WIS). OUTER (Team 6, 13 Aug 1975, UWL). RASPBERRY (J 6877). ROCKY (J 8902). SAND (J 8557). SOUTH TWIN (J 6830). STOCKTON (J 9856). YORK (J 8825).
- Rosa carolina L., pasture rose. Uncommon, clearings. BASSWOOD (Team 6, 26 Jun 1975, UWL). SOUTH TWIN (Cochrane & Cochrane 9337, WIS).
- Rosa palustris Marshall, swamp rose. Uncommon, clearings and old fields. BASS-WOOD (Middleton s.n., 14 Aug 1980, APIS). LONG (J 7992). MADELINE (Goessl 8027, MIL). OUTER (Lane 2505, WIS).
- \*Rosa rugosa Thunb., Japanese rose. Uncommon, clearings and shores. BEAR (W coast clearing; *J 6982*). HERMIT (S beach campsite; *J 9503*). LONG (sand cut and dunes; *Tans 1898*, MIL). MADELINE (La Pointe; *J 8759*).
- Rubus allegheniensis Porter, common blackberry. Common, coasts and clearings. BASSWOOD (K 8673, UWL). IRONWOOD (K 12769, UWL). MADELINE (Fuller 61–246, MIL). MANITOU (K 13623, UWL). OAK (Hildebrandt 284, APIS). OTTER (K 12859, UWL). OUTER (K 10923, UWL). RASPBERRY (K 14018, UWL). SAND (J 8521). SOUTH TWIN (K 10793, UWL). STOCKTON (Coffin 421, WIS). YORK (J 8815).
- Rubus canadensis L. (including R. elegantulus Blanchard and R. miscix L. Bailey), smooth blackberry. Common, coasts and clearings. BASSWOOD (K 8699, UWL). BEAR (J 9101). CAT (K 12071, UWL). HERMIT (J 7605). IRONWOOD (sand spit; Middleton s.n., 22 Jun 1982, APIS). LONG (K 7545, WIS). MADELINE (Fuller 61–217-a, WIS). MANITOU (J 7141). MICHIGAN (J 9517). OAK (K 10721, UWL). OTTER (K 12851, UWL). OUTER (K 10937, UWL). ROCKY (Cochrane & Cochrane 9290, MIL). SOUTH TWIN (Cochrane & Cochrane 9320, WIS). STOCKTON (J 8464).
- Rubus flagellaris Willd. (including R. grandidens L. Bailey and R. plicatifolius Blanchard), common eastern dewberry. Uncommon, thickets. MADELINE (Fuller 61-215, WIS). MANITOU (J 7138).
- Rubus hispidus L., swamp dewberry. Occasional, acid peaty swales and bog margins. BEAR (J 7012). HERMIT (K 13380, UWL). LONG (K 8810, UWL). MADELINE (Gerst s.n., WIS). MAINLAND (K 8589, UWL). MICHIGAN (K 13697, UWL). OAK (Hildebrandt 344, APIS). OUTER (J 9580). RASPBERRY (Dobie 94, APIS).
- Rubus parviflorus Nutt., thimbleberry. Fairly common, coasts and clearings, inner islands. BASSWOOD (Lane 2413, WIS). BEAR (NE cove; J 7523). DEVILS (rare, N tip; J 6728). HERMIT (Lane 2154, WIS). IRONWOOD (rare, W coast; J 6195). MADELINE (Kruschke 65-36, MIL). MAINLAND (K 8350, UWL). MANITOU (Team 1, UWL). MICHIGAN (K 13702, UWL). OAK (common; Beals AP-64, WIS). OTTER (J 6439). OUTER (sight record, R. B. Brander: not noted in present study). RASPBERRY (Dobie 21, WIS). ROCKY (J 6767). SAND (Cheney 6184, WIS). STOCKTON (Perkins s.n., 21 Jun 1976, UWSP).

- Rubus pubescens Raf., dwarf raspberry. Fairly common, swampy woods. BASSWOOD (K 8272, UWL). BEAR (J 7065). DEVILS (J 6714). HERMIT (Team 3, UWL). MADELINE (Goessi 8050, MIL). MAINLAND (K 8206, UWL). NORTH TWIN (J 6562). OAK (J 7748). OUTER (J 7514). SAND (Cheney 6183, WIS). STOCKTON (J 8455). YORK (J 7705).
- Rubus setosus Bigelow (including R. glandicaulis Blanchard, R. navus L. Bailey, R. stipulatus L. Bailey, R. superioris L. Bailey, R. vermontanus Blanchard, and R. wheeleri L. Bailey), bristly blackberry. Fairly common, clearings. BASSWOOD (Rudd Farm; Middleton s.n., 30 Jul 1980, APIS). IRONWOOD (K 12701, UWL). MADELINE (Fuller 4424, MIL). SAND (J 8197). SOUTH TWIN (Clements ST-55, UWL). STOCKTON (K 8851, WIS).
- Rubus strigosus Michaux, red raspberry. Common, clay bluffs and clearings. BASS-WOOD (K 8411, WIS). BEAR (J 9123). CAT (K 12069, UWL). DEVILS (Cochrane & Cochrane 9196, WIS). EAGLE (J 7854). GULL (occasional; J 7882). HERMIT (J 9459). IRONWOOD (J 7991). LONG (Cheney 5319, WIS). MADELINE (Fuller 4420, MIL). MAINLAND (K 8526, UWL). MANITOU (J 7134). MICHIGAN (J 7437). NORTH TWIN (J 9650). OAK (Beals AP-210, WIS). OUTER (Lane 2207, WIS). OUTER (J 7516). RASPBERRY (J 8945). ROCKY (Team 5, UWL). SAND (J 8551). SOUTH TWIN (J 8845). STOCKTON (Clements ST-45, UWL). YORK (K 11455, UWL).
- \*Sorbaria sorbifolia (L.) A. Braun, false spiraea. Rare. SAND (Shaw Farm, slightly spreading from cultivation; J 6038).
- Sorbus americana Marshall, American mountain-ash. SAND (locally common, Lighthouse Point and Lighthouse Bay; *J* 6045).
- Sorbus decora (Sarg.) Schneider, showy mountain-ash. Common, coastal bluffs and shores; less common inland. BASSWOOD (Cheney 5783, WIS). BEAR (J 7066).
  CAT (J 6166). DEVILS (J 6713). EAGLE (J 7845). GULL (fairly common; J 7890).
  HERMIT (J 7529). IRONWOOD (J 6264). LONG (Cheney 5347, WIS). MADELINE (Gerst s.n., WIS). MAINLAND (K 8595, UWL). MANITOU (J 7169). MICHIGAN (J 9520). NORTH TWIN (J 6514). OAK (Goessl 7896, WIS). OTTER (J 6392). OUTER (J 7517). RASPBERRY (J 8974). ROCKY (K 11801, UWL). SAND (J 8282). SOUTH TWIN (Heidel s.n., Aug 1977, UWL). STOCKTON (Perkins s.n., 21 Jun 1976, UWSP). YORK (K 11492, APIS).
- Spiraea alba Duroi, meadowsweet. Occasional, bog shrub layers, acid swales, and shores. DEVILS (sight record: W. Tans). LONG (Cheney 5417, WIS). MADELINE (Goessl 7963, MIL). MICHIGAN (J 7443). OAK (J 7761). OUTER (Jackson & Sheldon 197, WIS). RASPBERRY (K 13991, UWL). ROCKY (J 6781). SOUTH TWIN (airstrip; Heidel s.n., 14 Aug 1977, UWL). STOCKTON (K 9994, UWL).
- \*Spiraea ×vanhouttei (Briot) Carrière, bridal-wreath. Rarely persisting from cultivation. MICHIGAN (lighthouse; *J 7400*). SAND (East Bay cabins; *J 8270*).
- Waldsteinia fragarioides (Michaux) Tratt., barren-strawberry. Rare, young woods and clearings. DEVILS (N tip clearing; *J 9006*). STOCKTON (NW¹/4 of SW¹/4, Sec. 25; *J 8502*).

#### RUBIACEAE (Madder Family)

- Galium asprellum Michaux, rough bedstraw. Uncommon. LONG (W tip ephemeral pond margin; J 8593). MADELINE (Beals AP-172, WIS). MAINLAND (K 8928, UWL).
- Galium boreale L., northern bedstraw. Occasional, old clearings. BASSWOOD (Rudd, Jacobsen, and W dock clearings; *J 8140*). STOCKTON (Anderson Bay clearing; *J 9861*. W coast clearing; *J 9148*).
- Galium lanceolatum Torrey, yellow wild licorice. OAK (rare, trailside through deciduous woods at SE summit; J 7721).
- Galium obtusum Bigelow, wild madder. OTTER (rare, muddy trail through deciduous forest, NE1/4 of NW1/4, Sec. 12; J 9759).
- Galium tinctorium L. Common, swamps, beaver flowages, and muddy spots in forests. BASSWOOD (K 8679, UWL). BEAR (J 9733). CAT (J 9219). LONG (J 8591).

MADELINE (Cheney 5681, WIS). MANITOU (J 9042). MICHIGAN (K 13887, UWL). NORTH TWIN (J 6550). OUTER (Fraundorf s.n., 26 Aug 1978, UWSP). RASPBERRY (J 6900). ROCKY (Dobie 150, WIS). SAND (J 6034). SOUTH TWIN J 8492). STOCKTON (Escoll 274, MIL). YORK (J 9950).

Galium trifidum L. Occasional, wetlands. DEVILS (J. 6622). LONG (J. 8604). MAIN-LAND (K. 8927, UWL). RASPBERRY (Middleton s.n., 2 Aug 1978, APIS). STOCK-TON (Lane 2355, WIS).

Galium triflorum Michaux, sweet-scented bedstraw. Common, upland woods. BASS-WOOD (K 8672, UWL). BEAR (J 7058). CAT (Team 6, UWL). DEVILS (J 6708). GULL (Middleton s.n., 25 May 1979, APIS: not noted in 1991). HERMIT (J 7591). IRONWOOD (J 6217). MADELINE (Beals AP-110, WIS). MAINLAND (K 8540, UWL). MANITOU (Team 1, UWL). MICHIGAN (J 7305). NORTH TWIN (J 6591). OAK (Goessl 7916, MIL). OTTER (J 6390). OUTER (Stanley s.n., 24 Sep 1985, UWSP). RASPBERRY (J 6879). ROCKY (Cochrane & Cochrane 9266, WIS). SAND (J 8276). SOUTH TWIN (Heidel s.n., UWL). STOCKTON (K 10802, UWL). YORK (K 11399, UWL).

Mitchella repens L., partridge-berry. Occasional, upland woods; perhaps decreasing in abundance as forests mature. BASSWOOD (K 8676, UWL). BEAR (sight record: K.E. Larsen, 1974). HERMIT (J 7616). MADELINE (Beals AP-161, WIS). MAINLAND (K 8578, UWL). MICHIGAN (sight record: R. B. Brander, 1978). OAK (Hildebrandt 220, APIS). OUTER (fairly common, central part; Team 6, UWL). STOCKTON (occasional, especially on N slope; Verch & Riva s.n., 14 Jul 1973, NCAW).

## SALICACEAE (Willow Family)

Populus balsamifera L., balsam-poplar. Occasional to fairly common, especially on coastal clay bluffs. BASSWOOD (J 8341). BEAR (J 6969). CAT (J 6125). DEVILS (Middleton s.n., 10 Jun 1979, APIS). EAGLE (J 7857). IRONWOOD (J 6227). LONG (J 7943). MADELINE (J 8128). MANITOU (J 7219). MICHIGAN (J 7282). NORTH TWIN (J 6565). OAK (J 7735). OTTER (J 9752). OUTER (Tans s.n., 23 Aug 1971, WIS). RASPBERRY (Middleton s.n., 11 Jun 1980, APIS). ROCKY (J 9701). SAND (J 8286). SOUTH TWIN (J 8844). STOCKTON (J 8416). YORK (J 7678).

Populus deltoides Marshall, cottonwood. Rare. LONG (dunes of filled-in breach; J 7962). MADELINE (La Pointe, slightly spreading from cultivation; J 8122).

Populus grandidentata Michaux, large-toothed aspen. Fairly common, disturbed woods. BASSWOOD (Lane 2391, WIS). BEAR (J 9120). CAT (J 6175). GULL (sight record: W. Tans, 1977; not present in 1991). HERMIT (J 7561). LONG (J 8371). MADELINE (J 9388). MANITOU (J 7201). MICHIGAN (J 7265). NORTH TWIN (sight record: W. Tans). OAK (J 7745). OTTER (J 6336). OUTER (J 9581). ROCKY (J 8935). SAND (J 8231). SOUTH TWIN (J 6455). STOCKTON (Verch & Riva s.n., 9 Aug 1975, NCAW).

Populus tremuloides Michaux, quaking aspen. Common, young woods. BASSWOOD (J 8131). BEAR (J 6968). CAT (J 6167). DEVILS (J 6718). EAGLE (J 7813). GULL (sight record: Koch, 1982; not noted in 1991). HERMIT (J 7601). IRONWOOD (J 6228). LONG (J 7946). MADELINE (J 8084). MANITOU (J 7139). MICHIGAN (J 7391). NORTH TWIN (J 6586). OAK (J 7778). OTTER (J 6433). OUTER (J 7492). RASPBERRY (J 8020). ROCKY (J 8887). SAND (J 8189). SOUTH TWIN (Heidel s.n., UWL). STOCKTON (Verch & Riva s.n., 9 Aug 1973, NCAW). YORK (K 11407, UWL).

Salix amygdaloides Andersson, peach-leaved willow. Rare. MICHIGAN (sandy washover area between beach and lagoon; J 9525).

Salix bebbiana Sarg., long-beaked willow. Common, shores and clearings. BASS-WOOD (K 8413, WIS). BEAR (J 9118). CAT (J 9261). DEVILS (Cochrane & Cochrane 9223, WIS). HERMIT (J 7534). IRONWOOD (J 6234). LONG (K 7372, WIS). MADELINE (Cheney 5679, WIS). MAINLAND (K 8479, WIS). MICHIGAN (K 13706, UWL). NORTH TWIN (J 9654). OAK (Hildebrandt 354, APIS). OTTER (J

- 6414). RASPBERRY (*Dobie 114*, WIS). ROCKY (*J 9698*). SAND (*Cheney 6187*, WIS). SOUTH TWIN (*J 8833*). STOCKTON (*J 8443*). YORK (*J 8786*).
- Salix candida Flügge, sage-leaved willow. Rare; sterile specimen annotated by G. Argus as "candida or hybrid?" LONG (one plant in alder-willow swale W of lighthouse; J 8352).
- Salix discolor Muhlenb., pussy willow. Fairly common, shores. BEAR (J 8005). DEVILS (J 9002). EAGLE (J 7793). HERMIT ("probably" this species [G. Argus]; J 7565). IRONWOOD (Clements 150, UWL). LONG (J 8385). MADELINE (Lapham s.n., Sep 1858, WIS). MICHIGAN (Middleton s.n., 11 Jul 1982, APIS). NORTH TWIN (J 9657). OAK (J 7739). OTTER (J 6471). OUTER (K 13443, UWL). SOUTH TWIN (J 6503). STOCKTON (J 8469). YORK (J 9954).
- Salix eriocephala Michaux, heart-leaved willow. Locally common, sand spit dunes; less common on clay or rock shores. CAT (E coast rocks; J 6106). LONG (abundant; K 7511, WIS). MADELINE (Grants Point; J 8743). MICHIGAN (sand spit washover; J 9539). OAK (J 7756). ROCKY (W coast clay bluffs; J 9702). SAND (ledges N of Justice Bay; J 9783). YORK (ledges; J 8789).
- Salix exigua Nutt., sandbar willow. Occasional, sand spits and clay bluffs. BEAR (W coast clay bluffs; J 9732). LONG (K 7560, WIS). MADELINE (Cheney 5727, WIS). MAINLAND (K 8521, UWL). MICHIGAN (Middleton s.n., 9 Jul 1982, APIS). OAK (Middleton s.n., 14 Jun 1978, APIS). OUTER (Lane 2705, NCAW). ROCKY (W coast clay bluffs; J 9700). STOCKTON (NW spit; J 9134).

\*Salix fragilis L., crack willow. Rarely naturalized. MICHIGAN (sand spit washover, "probably fragilis" [G. Argus]; J 9528).

- Salix gracilis Andersson, slender willow. Common, shores. BASSWOOD (J 8344). BEAR (J 6967). CAT (J 9246). DEVILS (J 9000). LONG (Cheney 5400, WIS). MADELINE (Lapham s.n., Sep 1858, WIS). MANITOU (J 9050). NORTH TWIN (J 9596). OAK (J 8391). OUTER (J 9643). ROCKY (Tans 1586, WIS). SAND (J 8668). SOUTH TWIN (J 6510). STOCKTON (J 8468). YORK (J 8802).
- Salix humilis Marshall, upland or prairie willow. Common, shores and clearings. BASSWOOD (*J 8136*). BEAR (NE point; *J 9119*). DEVILS (W landing; *J 9974*). MADELINE (*J 9834*). MANITOU (*Lane 2593*, WIS). NORTH TWIN (*J 6597*). OTTER (*J 9762*). OUTER (*Tans 30*, WIS). ROCKY (*J 8924*). SAND (*J 8530*). SOUTH TWIN (*J 6491*). STOCKTON (*J 8466*).
- Salix lucida Muhlenb., shining willow. Fairly common, shores, especially rocky ones. DEVILS (J 9008). LONG (K 7510, WIS). MADELINE (Goessl 7975, MIL). MAIN-LAND (Sand Bay; Cheney 6363, WIS). MICHIGAN (sight record: J). OTTER (sight record: J). OUTER (Tans s.n., 23 Aug 1971, WIS). ROCKY (N coast ledges; J 9718). STOCKTON (J 8467). YORK (sight record: J, common, isthmus marsh).
- Salix myricoides Muhlenb., blueleaf willow. Rare. LONG (along pathway through moist woods; K 7388, WIS).
- Salix pedicellaris Pursh, bog willow. Fairly common, bogs. LONG (Cheney 5338, WIS). MADELINE (J 8086). MAINLAND (Sand River bog; J 9871.5). MICHIGAN (J 7449). OUTER (Fraundorf s.n., 13 Sep 1978, UWSP). RASPBERRY (J 6928). STOCKTON (Lane 2761, NCAW). YORK (J 8800).
- Salix pellita Schneider, satiny willow. Rare, coasts; the first Wisconsin collections. CAT (rare, E coast rocks to sand spit; *J 6240*). OTTER (one clump on gravelly shore on S side of sand spit; *J 6428*).
- Salix planifolia Pursh, flat-leaved willow. Rare, coastal rocks; the first Wisconsin collections. CAT (W coast; J 6127. E coast, 600 m S of log landing, J 9238). DEVILS (W landing; Middleton s.n., 10 Jun 1979, APIS; J 8997; "or possible hybrid" [G. Argus]: J 6715). OUTER (Austad Bay; J 7478).
- Salix pyrifolia Andersson, balsam willow. Fairly common, bogs, acid swales, rock ledges. CAT (J 9243). DEVILS (J 9004). LONG (J 8369). MADELINE (Cheney 5673, WIS). MAINLAND (Cheney 6443, WIS). MICHIGAN (J 9522). OUTER (Team 3, UWL). RASPBERRY (Middleton s.n., 2 Aug 1978, APIS). STOCKTON (J 8424). YORK (J 8785).
- \*Salix ×rubens Schrank (S. alba × S. fragilis). Occasional tree, disturbed shores.

LONG (common, bayshore; *J 8390*). MADELINE (*Goessl 7987*, MIL). RASP-BERRY (dock; *J 8968*). ROCKY (dock; *J 6815*). STOCKTON (Presque Isle dock; *J 8444*).

Salix serissima (L. Bailey) Fern., autumn willow. Uncommon, shores. MADELINE (Goessl 7965, MIL). OUTER (trailside, S flowage; Fraundorf s.n., 26 Aug 1978, UWSP).

## SANTALACEAE (Sandalwood Family)

Comandra umbellata (L.) Nutt., bastard-toadflax. Fairly common, sand spit dunes and pine woods. BEAR (J 9748). LONG (K 7552, WIS). MADELINE (Bobb 175, WIS). OAK (Hildebrandt 183, APIS). OUTER (Lane 2717, WIS). RASPBERRY (Dobie 105, WIS). ROCKY (sight record: R. Dobie, 1976). STOCKTON (K 6993).

## SARRACENIACEAE (Pitcher-plant Family)

Sarracenia purpurea L., pitcher-plant. Common, bogs. BEAR (rare, summit bog; J 9103). LONG (K 8793, UWL). MADELINE (Grether 7220, WIS). MAINLAND (K 8612, UWL). MICHIGAN (K 11719, UWL). OUTER (Fraundorf s.n., 13 Sep 1978, UWSP). ROCKY (Cochrane & Cochrane 9351, WIS). STOCKTON (Lane 2763, WIS).

## SAXIFRAGACEAE (Saxifrage Family)

Chrysosplenium americanum Hooker, golden saxifrage. Uncommon, ravine bottoms and wet trailsides. MADELINE (J 8691). SAND (J 8201). STOCKTON (Verch & Riva s.n., 1 Jun 1974, NCAW).

Mitella nuda L., naked mitrewort. Occasional, woods, especially in ravine bottoms. DEVILS (N tip krumholtz; J 6744). HERMIT (J 8067). MAINLAND (K 8376, UWL). NORTH TWIN (N tip krumholtz; J 6558). OAK (common, ravines; Lane 2252, WIS). OTTER (J 9767). OUTER (sight record: J). STOCKTON (J 9160).

Parnassia palustris L., marsh grass-of-parnassus. Rare. OUTER (common, N coast clay bluffs; J 6005).

Ribes americanum Miller, wild black currant. Uncommon, woods. BASSWOOD (J 8138). MADELINE (Goessl 7961, MIL).

Ribes glandulosum Grauer, skunk currant. Common, swampy woods. BASSWOOD (K 8447). BEAR (J 7032). CAT (J 6121). DEVILS (J 6682). EAGLE (J 7846). GULL (K 13930, UWL: not noted, 1991). HERMIT (J 7588). IRONWOOD (J 6237). LONG (K 7542, WIS). MADELINE (Beals AP-148, WIS). MAINLAND (Cheney 6296, WIS). MANITOU (J 7132). MICHIGAN (Team 5, UWL). NORTH TWIN (J 6571). OAK (Lane 2255, WIS). OTTER (J 6477). OUTER (Fraundorf s.n., 4 Jul 1978, UWSP). RASPBERRY (J 6902). ROCKY (Cochrane & Cochrane 9360, WIS). SAND (Cheney 6155, WIS). SOUTH TWIN (Team 4, UWL). STOCKTON (K 13743, UWL). YORK (Cottam & Vogl 670, WIS).

Ribes hirtellum Michaux, smooth gooseberry. Occasional in woods. BASSWOOD (*J 8331*). GULL (*Lane 2787*, NCAW; *K 13913*, UWL: not noted in 1991). HERMIT (quarry; *J 7630*). MADELINE (*J 8686*). ROCKY (*J 6802*). SAND (*J 8244*). STOCKTON (*J 8484*).

\*Ribes rubrum L., red currant. Rarely persisting from cultivation. BASSWOOD (McCloud Farm; J 8161).

Ribes triste Pallas, swamp red currant. Occasional, swampy deciduous woods and alder thickets. BASSWOOD (J 8149). MADELINE (Cheney 5662, WIS). MICHIGAN (J 7337). OAK (J 7780). OUTER (sight records: R. Anderson, J). SAND (Justice Bay; J 8240). STOCKTON (J 8461).

## SCROPHULARIACEAE (Figwort Family)

Agalinis tenuifolia (Vahl) Raf., slender gerardia. Rare. MADELINE (shore of old marina; J 9815).

Chelone glabra L., turtlehead. Uncommon, marshes and shores. HERMIT (Cheney 5891, WIS). LONG (sand cut; J 8617). MADELINE (J 9832). MAINLAND (K 9067B, UWL). OUTER (beaver flowage, Sec. 23; Fraundorf s.n., 8 Aug 1978, UWSP).

- \*Digitalis purpurea L., foxglove. MICHIGAN (cultivated at lighthouse; J 9555).
- Gratiola neglecta Torrey, hedge-hyssop. Rare; not noted in present study. IRONWOOD (sand spit; Lane 2373, WIS).
- \*Linaria dalmatica (L.) Miller, Dalmatian toadflax. MADELINE (Uncommon weed, roadsides; J 8753).
- \*Linaria vulgaris Hill, butter-and-eggs. Uncommon weed. IRONWOOD (Collins 223, UWL). LONG (shores; J 7931). MICHIGAN (without collector, APIS).
- Melampyrum lineare Desr., cow-wheat. Common under pines on sand spits and bluff edges. BASSWOOD (Lane 2418, WIS). BEAR (J 6949). CAT (J 6151). DEVILS (J 6697). HERMIT (J 7619). LONG (K 8809, UWL). MADELINE (Cull s.n., Aug 1947, WIS). MAINLAND (K 8537, UWL). MANITOU (J 7237). MICHIGAN (J 7310). NORTH TWIN (Cottam & Vogl 544, WIS). OAK (Goessl 7894, MIL). OTTER (K 11608, UWL). OUTER (Cottam & Vogl 639, WIS). ROCKY (J 6796). SAND (J 8304). SOUTH TWIN (J 6460). STOCKTON (Taylor 3619, MIL). YORK (J 7677).
- Mimulus ringens L., monkey-flower. Rare, wetlands. LONG (Cheney 5380, WIS). MADELINE (Goessl 7996, MIL).
- Scrophularia lanceolata Pursh, figwort. Common, old fields and coastal clearings. BASSWOOD (Rudd Farm; Middleton s.n., 30 Jul 1980, APIS). BEAR (W clearing; J 6987). CAT (NW clearing; J 6183). HERMIT (Lane 2778, WIS). IRONWOOD (J 6276). LONG (K 8806, UWL). MADELINE (J 8114). MAINLAND (K 8556, UWL). MANITOU (J 7165). MICHIGAN (J 7299). OAK (Fassett et al. 19939, WIS). OTTER (J 6309). RASPBERRY (Dobie 126, WIS). SAND (J 8314). SOUTH TWIN (J 6839). STOCKTON (K 10817, UWL).
- \*Verbascum phlomoides L., clasping-leaved mullein. Rare weed. MADELINE (driveway gravel, SE1/4 of SE1/4, Sec. 29; J 9359).
- \*Verbascum thapsus L., common mullein. Occasional weed of clearings and clay bluffs, apparently becoming less common than formerly. MADELINE (J 8083). MAINLAND (K 8891, UWL). MANITOU (fish camp; J 7252). OAK (J 9434). RASPBERRY (K 13993, UWL). ROCKY (sight record: W. Tans). STOCKTON (Verch & Riva s.n., 23 Jul 1973, NCAW). YORK (sight record: R. Dobie).
- Veronica americana (Raf.) Schwein., American brooklime. Occasional, ravine mouths and alder thickets. BASSWOOD (K 8470, UWL). IRONWOOD (Lane 2691, WIS). LONG (K 10516, UWL). MADELINE (Goessl 7982, MIL). OAK (Lane 2216, WIS). STOCKTON (Quarry Bay ravine; J 9174).
- \*Veronica arvensis L., corn speedwell. Occasional weed. MADELINE (Sec. 8, along Co. H; J 9380). OAK (sand spit; Hildebrandt 177, APIS; J 8404). ROCKY (Nies fish camp; Cochrane & Cochrane 9413, WIS). SOUTH TWIN (J 9032). STOCKTON (Presque Isle dock; J 9559).
- \*Veronica longifolia L., long-leaved speedwell. MADELINE (escaped to ditch in La Pointe; J 9882).
- \*Veronica officinalis L., common speedwell. Uncommon weed. IRONWOOD (sand spit; *J 6289*). MADELINE (Grants Point; *J 8125*. airport; *J 8769*). OUTER (SE<sup>1</sup>/<sub>4</sub>, Sec. 19; Fraundorf s.n., 8 Jul 1978, UWSP).
- \*Veronica peregrina L., purslane speedwell. RASPBERRY (garden weed; J 9930).
- \*Veronica serpyllifolia L., thyme-leaved speedwell. Common, trails and muddy open ground. BASSWOOD (K 8470-b, UWL). BEAR (J 7078). DEVILS (J 6755). EAGLE (J 7849). IRONWOOD (J 6272). MADELINE (Goess! 5719, WIS). MAINLAND (K 8236, UWL). MANITOU (J 7185). MICHIGAN (J 7329). OAK (J 7766). OTTER (J 6368). OUTER (J 6082). RASPBERRY (Dobie 111, WIS). ROCKY (Cochrane & Cochrane 9262, WIS). SAND (J 6032). SOUTH TWIN (J 6499). STOCKTON (J 8436).

## SOLANACEAE (Nightshade Family)

- Physalis heterophylla Nees, clammy ground-cherry. Rare, clearings. OAK (well-established at edge of dock clearing; J 9446). RASPBERRY (sight record: R. Dobie, 1976).
- \*Solanam dulcamara L., bittersweet nightshade. Disturbed areas. IRONWOOD (sand

spit; Collins 259, UWL: not noted in 1991-1992). LONG (fairly common, shores; J 8614). MADELINE (occasional, La Pointe and elsewhere; J 8574).

Solanum ptycanthum DC., black nightshade. Rare, disturbed areas. IRONWOOD (sand pit; Lane 2379, WIS: not noted in 1991–1992). RASPBERRY (garden weed; J 9928).

## TILIACEAE (Basswood Family)

Tilia americana L., basswood. Occasional, rich upland woods. BASSWOOD (J 8144). BEAR (J 7099). CAT (J 6184). HERMIT (Team 6, UWL). IRONWOOD (J 6303). LONG (J 8357). MADELINE (J 8738). MAINLAND (K 8885, UWL). MANITOU (J 7181). MICHIGAN (J 7336). OAK (J 7729). OTTER (J 6363). OUTER (J 9601). RASPBERRY (J 8957). ROCKY (J 6807). SAND (sight record: R. Anderson). SOUTH TWIN (J 6511). STOCKTON (J 8448).

## ULMACEAE (Elm Family)

Ulmus americana L., American elm. Uncommon, swampy woods. BASSWOOD (sight record: R. B. Brander). LONG (*J 7961*). MADELINE (*Goessl 7957*, MIL). OAK (sight record: J. Hildebrandt, from "seepage area at island's summit"). ROCKY (*J 6760*). STOCKTON (NE<sup>1</sup>/<sub>4</sub> of NE<sup>1</sup>/<sub>4</sub>, Sec. 27; *J 9176*).

## UMBELLIFERAE (Parsley Family)

- \*Carum carvi L., caraway. Occasionally persisting and spreading, old clearings. MADELINE (Cheney 5610, WIS). MAINLAND (K 8568B, UWL). RASPBERRY (Dobie 51, WIS). SAND (East Bay; J 8559).
- Cicuta bulbifera L., bulblet-bearing water-hemlock. Occasional, swamps, bogs, and beaver flowages. HERMIT (*J 9471*). LONG (*K 9109*, UWL). MADELINE (*J 8685*). OUTER (*Fraundorf s.n.*, 10 Aug 1978, UWSP). RASPBERRY (*Dobie 106*, WIS). ROCKY (sight record: W. Tans). SAND (*J 8565*). STOCKTON (*J 9156*). YORK (sight record: R. Dobie).
- Cicuta maculata L., spotted water-hemlock. Occasional, swamps and wet trails. DEV-ILS (sight record: T.S. Cochrane, 1 Jul 1980). HERMIT (*J 9489*). LONG (Cheney 5421, WIS). MADELINE (*J 8737*). MAINLAND (*K 8915*, UWL). OAK (sand spit alders; Hildebrandt 216, APIS). OUTER (*J 6058*). SAND (*J 8327*).
- Cryptotaenia canadensis (L.) DC., honewort. Rare. OTTER (local, trail through hardwoods; Bowers 11741-a, UWSP).
- Heracleum lanatum Michaux, cow-parsnip. Occasional, overgrown clearings. BASS-WOOD (Team 6, UWL). EAGLE (common, S tip; J 7794). HERMIT (J 7649).
  MADELINE (Cheney 5665, WIS). MAINLAND (K 8935, UWL). MICHIGAN (J 7317). OAK (N bay ravine mouth; Goessl 7920, in 1917, MIL: still present in 1992).
  OUTER (lighthouse woods; Fraundorf s.n., 2 Jul 1978, UWSP). RASPBERRY (Dobie 42, WIS). SAND (rare; J 8324). STOCKTON (Clements 334, APIS).
- Osmorhiza chilensis Hooker & Arn., Chilean sweet cicely. Fairly common, upland woods. BASSWOOD (K 8283, WIS). BEAR (J 6956). CAT (J 6105). DEVILS (J 6636). GULL (Middleton s.n., 25 May 1979, APIS: not noted in 1991). HERMIT (J 7593). IRONWOOD (J 6245). MADELINE (Tans 1345, MIL). MAINLAND (K 8250, UWL). MANITOU (K 13578, UWL). MICHIGAN (J 8052). OAK (Jones s.n., WIS). OTTER (J 6409). OUTER (K 10960, UWL). RASPBERRY (Dobie s.n., 16 Jun 1976, WIS). ROCKY (J 8895). SAND (J 8209). SOUTH TWIN (J 8847). STOCKTON (K 8847, UWSP). YORK (J 8827).
- Osmorhiza claytonii (Michaux) C.B. Clarke, hairy sweet cicely. Rare. MAINLAND (E of Sand Bay; Cheney 6414, WIS).
- \*Pastinaca sativa L., parsnip. Occasionally persisting and spreading, clearings. BEAR (W clearing; *J 6989*). MADELINE (*Goessl 7988*, MIL). MANITOU (sight record: J). MICHIGAN (fish camp; *J 7393*). OUTER (lighthouse steps; *J 9585*). SAND (Shaw Farm; *J 9289*).
- Sanicula marilandica L., black snakeroot. Occasional, upland woods and ravine bottoms. BASSWOOD (K 8442, WIS). MADELINE (K 10448, UWL). OAK (Fairly

common; Goessl 7917, MIL). STOCKTON (Verch & Riva s.n., 28 Jun 1973, NCAW).

Sium suave Walter, water-parsnip. Fairly common, beaver flowages, alder thickets, and bogs. BASSWOOD (J 9350). BEAR (J 9092). MADELINE (J 8707). MAINLAND (Sand River; Carlson s.n., 17 Sep 1988, APIS). MANITOU (J 9063). RASPBERRY (E tip alders; J 9906). ROCKY (J 8907). SAND (sight record: R. Koch). STOCKTON (J 9155). YORK (Dobie 189, WIS).

Zizia aurea (L.) Koch, golden alexanders. Rare. MAINLAND (wooded ravine bottom, Sec. 3 of T51N, R5W; J 8569).

## URTICACEAE (Nettle Family)

Laportea canadensis (L.) Wedd., wood-nettle. Uncommon, ravine bottoms. MADE-LINE (SW1/4 of NW1/4, Sec. 28; J 9373). STOCKTON (Verch & Riva s.n., 23 Jul 1973, NCAW).

Pilea pumila (L.) A. Gray, clearweed. Rare. OTTER (trailside weed; J 6356).

Urtica dioica L., stinging nettle. Occasional, moist disturbed woods and clearings. BASSWOOD (J 8137). LONG (J 7933). MADELINE (Cheney 5607). MANITOU (J 7190). MICHIGAN (J 7308). OAK (Hildebrandt 241, APIS). OTTER (J 6308). ROCKY (J 6780). STOCKTON (K 10001, UWL). YORK (sight record: R. Dobie; not present in 1992).

## VALERIANACEAE (Valerian Family)

\*Valeriana officinalis L., garden heliotrope; valerian. MADELINE (Naturalized and spreading in ditches along Rice Street, La Pointe; J 8758).

## VERBENACEAE (Vervain Family)

\*Verbena bracteata Lagasca & Rodríguez, creeping vervain. MADELINE (street weed in La Pointe; J 9825).

Verbena hastata L., blue vervain. Uncommon, shores, clearings, and roadsides. LONG (occasional from W tip to sand cut; J 8600). MADELINE (Hagen Road; J 9393). MANITOU (grassy clearing, SE beach; Lane 2591, WIS).

## VIOLACEAE (Violet Family)

Viola adunca Smith, hooked-spur violet. MADELINE (S Shore Rd., 1.6 km SE of

Chebomnicon Bay, in ditch, 10 Jun 1965, McCown 26, WIS).

Viola blanda Willd. (V. incognita Brainerd), sweet white violet. Common, woods. BASSWOOD (J 8329). BEAR (J 8004). CAT (J 6135). EAGLE (J 7826). IRON-WOOD (J 6302). MADELINE (J 8108). MANITOU (J 9039). MICHIGAN (J 7316). OAK (Fassett 20037, WIS). RASPBERRY (J 8032). ROCKY (Tans 1589, MIL). SAND (Cheney 6163, WIS). SOUTH TWIN (J 8839). STOCKTON (Verch & Riva s.n., 1 Jun 1974, NCAW). YORK (J 8775).

Viola blanda × V. renifolia. Rare. MICHIGAN (lighthouse woods; J 8055).

Viola cucullata Aiton, marsh blue violet. Common, mesic to swampy woods. BASS-WOOD (J 8159). BEAR (J 7071). EAGLE (J 7824). HERMIT (J 7640). MADELINE (Maycock 710, WIS). OAK (Goessl 7919, MIL). OTTER (J 6410). OUTER (J 6057). ROCKY (sight record: W. Tans). SAND (Cheney 6228, WIS). STOCKTON (Beals AP-36, WIS).

Viola lanceolata L., lance-leaved violet. Rare, wet sandy-peaty swales. OUTER (N part

of sand spit lagoon; J 6018). SOUTH TWIN (airstrip ditch; J 9022).

Viola macloskeyi F. Lloyd (V. pallens (Banks) Brainerd), smooth white violet. Common, woods and shores. BASSWOOD (J 8171). BEAR (J 9116). CAT (J 7564). DEVILS (J 9009). HERMIT (K 13400, WIS). IRONWOOD (J 6226). LONG (J 8382). MADELINE (Beals AP-204, WIS). MAINLAND (K 8137, UWL). MANI-TOU (J 7220). NORTH TWIN (J 6517). OTTER (J 6365). OUTER (Tans 27, WIS). RASPBERRY (J 9905). SAND (Cheney 6166, WIS). SOUTH TWIN (J 9023.5). STOCKTON (Beals AP-37, WIS). YORK (J 8809).

Viola nephrophylla E. Greene, northern bog violet. Rare. MADELINE (McCown 27, WIS). MICHIGAN (lighthouse lawn; J 8056).

Viola ×primulifolia L. (V. lanceolata × V. macloskeyi). Rare, sandy-peaty swales.

- MADELINE (Cooper s.n., 2 Sep 1936, MIN, WIS). SOUTH TWIN (NE end of airstrip; J 9023).
- Viola pubescens Aiton, yellow violet. Occasional, rich upland woods and ravines. BASSWOOD (J 8153). MADELINE (J 8105). MAINLAND (K 8140, UWL). MICHIGAN (J 7304). OAK (J 7751). OTTER (J 6371). OUTER (J 6060). ROCKY (Dobie 181, APIS). STOCKTON (R. Verch photograph no. 50).
- Viola renifolia A. Gray, kidney-leaved violet. Occasional, woods, ravines, and openings. BASSWOOD (J 8134). HERMIT (J 8066). LONG (J 8374). OAK (summit; J 8045).
- Viola sororia Willd., woolly blue violet. Occasional, trailsides and forest edges. DEV-ILS (road S of bog; J 8984). MADELINE (Hagen Road; J 8099). MICHIGAN (J 7316).

## VITACEAE (Grape Family)

- Parthenocissus inserta (A. Kerner) Fritsch, Virginia creeper. Occasional, shores, forest margins, and old clearings. HERMIT (Bruder Farm; J 9483). LONG (sand cut; J 7941). MADELINE (J 8755). RASPBERRY (bluff in front of lighthouse; J 8967). ROCKY (fish camp; K 11866, UWL).
- Parthenocissus quinquefolia (L.) Planchon. SAND (Shaw Farm, perhaps a relict of cultivation; J 9286).

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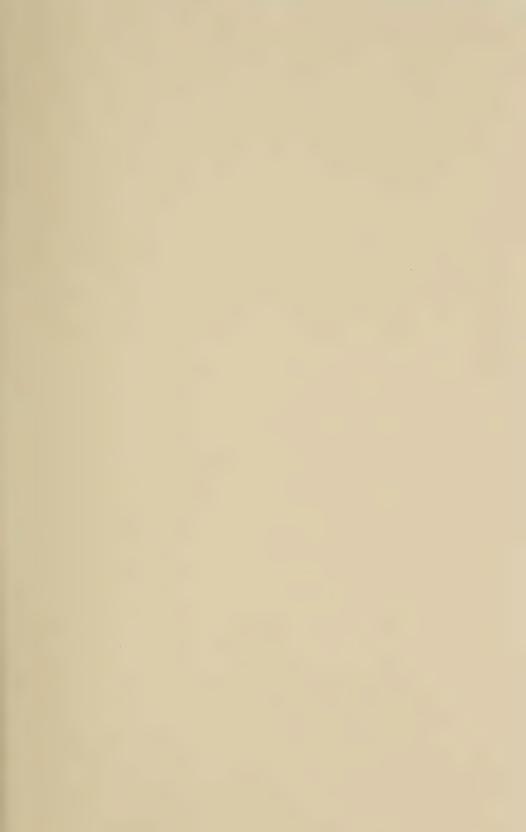
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On the cover: Manitou Island fish camp, representative of disturbed habitats throughout the islands. Along the shore (foreground to background) are quack grass (Agropyron repens), Canada goldenrod (Solidago canadensis), and reed canary-grass (Phalaris arundinacea). Bear Island, the third highest island, is on the horizon.

Photograph by E.J. Judziewicz, 28 July 1992.



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# THE EFFECT OF SEDIMENT LOADING ON GERMINATION FROM THE SEED BANK OF THREE MICHIGAN WETLANDS.

Robert K. Neely and James A. Wiler

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## **ABSTRACT**

Soil seed bank samples from an open water zone, a *Typha latifolia* zone, and a *Sparganium eurycarpum* zone were collected from three southeast Michigan wetlands. The seed bank samples were placed in trays in the greenhouse and subjected to sediment loadings ranging from 0 to 2.5 cm of applied sediment. The number of emerging seedlings differed significantly among vegetation zones but not among sites. Averaged for all wetlands, open water samples exhibited the highest germination (97.9 seedlings/kg) and *Typha* samples exhibited the lowest germination (62.0 seedlings/kg); however, this pattern was not statistically consistent within each wetland, i.e., ANOVA of germination patterns yielded a significant interaction between wetland site and vegetation zone.

Deposition of sediment over the seed bank samples seems to initially slow seedling emergence by 12-14%. For data pooled over all wetlands, however, no statistically significant effect of sediment loading on the number of emerging seedlings was observed. Nonetheless, a significant ANOVA interaction between sediment loading rate and vegetation zone suggested that any possible effects of sediment loading were a function of both loading rate and characteristics of the seed bank in a specific vegetation zone. For example, under low sediment loading conditions, germination for the open water samples and combined vegetation samples was reduced 3.0% and 21.2% respectively, in comparison to control samples which lacked sediment. Germination under high sediment loading was actually 73.3% higher for open water samples and 33.5% lower for vegetation zone samples compared with controls.

## INTRODUCTION

Wetlands are generally characterized by (1) saturated or inundated soil and (2) the presence of vegetation adapted to hydric soils and the prevailing hydrologic regime (Leck 1989). As unique, transitional habitats, wetlands provide or contribute to habitat and foodchain support for terrestrial and aquatic species, spawning grounds for fish, groundwater recharge, and floodwater retention. Wetlands have also been shown to remove undesirable contaminants from surface waters, e.g., coliform bacteria, suspended material, nitrogen, and phosphorus. Despite these positive functions, wetlands in the United States are being destroyed at a rate of approximately 450,000 acres per year with 56% of U.S. wetlands already drained, filled, or dredged (U.S. Department of Interior 1990). Additionally, many remaining wetlands are being negatively affected by agricultural runoff, sediment deposition, altered drainage patterns, etc.

The important functional features of a wetland are primarily attributable

to submersed and emergent vascular vegetation; thus, factors which directly or indirectly affect these plants may alter wetland function. An often overlooked component of wetland vegetation is the soil seed bank. Numerous studies have shown that many emergent plant species contribute to persistent seed banks (Baskin et al. 1989, Leck & Graveline 1979, Leck & Simpson 1987, van der Valk & Davis 1978a). These seed banks are unquestionably important in the vegetation ecology of aquatic systems. Beyond merely representing the past and perhaps future flora of a wetland, seed banks affect the maintenance of plant species diversity along lake shorelines (Keddy & Reznicek 1982, 1986), function in the cycles of vegetation regeneration in prairie marshes (Kantrud et al. 1989, van der Valk & Davis 1978b), may relate to polydominance in plant stands of some marshes (van der Valk & Davis 1980), and are an integral component of a proposed, qualitative model for understanding succession in freshwater wetlands (van der Valk 1981).

The purpose of this study was to examine the effect of sediment deposition on seedling recruitment from the seed bank of three wetlands in southeast Michigan. As a subtle form of disturbance, sedimentation has been described as an "insidious and widespread form of disturbance in wetlands" (Kantrud et al. 1989), presumably by burial of existing plants, benthic organisms, and the seed bank. The extent of sedimentation in wetlands has been documented in numerous studies with sedimentation rates generally ranging from less than 0.5 cm/yr to greater than 3-4 cm/yr (Davis 1976, Harrison & Bloom 1977, Mudie & Byrne 1980, Richard 1978, van der Valk & Bliss 1971, Walker 1970, and others). With respect to the vegetative components of wetlands, the effects of sedimentation are virtually unstudied (Darnell 1976, Kantrud et al. 1989); however, alteration of both submersed vegetation (Jackson & Starrett 1959) and emergent (van der Valk et al. 1983) plant communities has been suggested. At the least, it seems reasonable to assume that burial of the seed bank by sediments could eventually alter the plant species density and composition within a wetland by inhibiting germination success.

## METHODS AND MATERIALS

Sediment samples were collected in April, 1988 from each of three small palustrine marshes in southeast Michigan, Swift Run marsh (42°14′N, 83°42′28″W, Washtenaw County), an unnamed wetland near Saline, MI (42°11′30″N, 83°44′W) and an unnamed wetland in the Waterloo Recreational Area (42°18′N, 84°7′W). These wetlands are small (2 to 4 hectares) and shallow (0.5 to 2 m) with similar hydrology and dominant vegetation (*Typha latifolia* L. and *Sparganium eurycarpum* Engelm.).

Samples were collected in April to allow natural stratification of all seeds. A Ponar dredge was used to collect grab samples of the sediment surface to a depth of about 5 cm. Five replicate dredge samples were collected from an open water zone, an essentially monodominant zone of *Typha*, and an essentially monodominant zone of *Sparganium* for each marsh. These replicates were combined into one composite sample and stored at 4°C until initiation of the greenhouse germination study (approximately 1 week).

Five hundred-gram samples of dredged, wet sediment were placed in each of 81 shallow, plastic trays (22.9 cm  $\times$  22.9 cm  $\times$  5 cm). Large pieces of detritus, tubers, and rhizomes were removed from the sediment samples and the samples were mixed uniformly before transfer to a

tray. Care was taken to ensure that soil and seeds were not lost by removal of debris. Drainage holes were drilled into the trays so that water would not stand on the surface of the sediment samples.

All trays were subjected to one of three artificial sediment loading treatments: no sediment per tray (referred to as the control treatment henceforth), 100 gm of sediment per tray (0.75–1.0 cm depth of cover), and 250 gm of sediment per tray (2.0–2.5 cm depth of cover). The added sediment was commercial potting soil (Hyponex Corporation) which had been sterilized by autoclaving at 121°C and 15 PSI before deposition in each tray. Each sediment treatment was replicated in triplicate for each zone of each wetland (81 trays = 3 wetlands  $\times$  3 vegetation zones  $\times$  3 sediment treatments  $\times$  3 replicates). All sample trays were randomly arranged and placed in the Eastern Michigan University greenhouse where temperature fluctuated between 20–23°C during the study period. The surface of the samples was kept moist throughout the study with care taken not to disturb the soil surface.

Seed germination was monitored for 120 days from 14 May 1988 until 10 September 1988. Seedlings were removed from trays to prevent overcrowding. Examples of most seedling types were transplanted to other trays in an unsuccessful effort to allow seedlings to grow to maturity for species identification. Thus, we were not able to identify sedimentation effects on individual plant species.

The Statistical Analysis System (SAS 1985) was used to generate a 3-way analysis of variance (ANOVA) to determine significant differences in distribution of seedlings among wetlands, vegetation zones within wetlands, sediment loading treatments, and the relevant interactions between these factors. The distribution of seedling numbers was not tested for normality because the validity of an ANOVA is affected only slightly by great deviations from normality (Zar 1974, Little & Hills 1978). When the ANOVA showed significant differences among the three wetlands, three vegetative zones, or three sediment treatments, the Student-Newman-Keuls multiple range test was used to determine which pairwise comparisons were significantly different from one another (Zar 1974). Statistical significance was set at  $P \le 0.05$  confidence level.

## RESULTS

The first seedlings appeared approximately 5 days after the sample trays were placed in the greenhouse. By day 10, 91% of all sediment samples had at least one seedling. By day 20, 85% of the total germination in control samples had occurred. In contrast, only 71–73% of total germination occurred in the treatment samples (deposited sediment) over the same 20 day period (Fig. 1) and at least 35 days were required to reach greater than 90% germination for the sediment treatments. Although burial seems to have prolonged seedling emergence from the sediment by as much as two weeks, the higher sediment loading treatment actually exhibited faster and greater germination than the low sediment loading treatment, i.e., over 20 days, 753 total seedlings appeared under low sediment loading and 852 total seedlings appeared under high sediment loading.

An analysis of variance (ANOVA) of total germination demonstrated that the only statistically significant patterns were related to the vegetation zones (Table 1). Statistical differences were observed between (1) the number of seeds germinating from each vegetation zone, (2) the number of seeds germinating as a function of the wetland in which the vegetation zone was sampled (wetland × zone interaction) and (3) the number of seeds germinating from vegetation zones in response to the sediment treatment (loading × zone interaction).

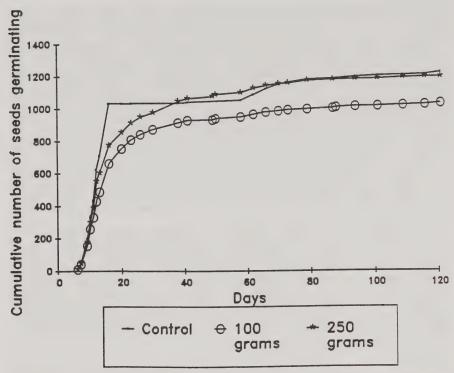


FIGURE 1. The total, cumulative number of seeds germinating from seed bank samples exposed to three sediment loading treatments in the greenhouse over 120 days.

The greatest germination occurred from open water samples (97.9  $\pm$  12.9 seedlings/kg of wetland sediment (wet weight)) and the lowest germination occurred in samples from the *Typha* zone (62.0  $\pm$  8.6 seedlings/kg). Germination from the *Sparganium* zone resulted in 94.8  $\pm$  12.9 seedlings/kg. The Student-Neuman-Keuls multiple range test indicated that germination from the open water and *Sparganium* samples was statistically differ-

TABLE 1: ANOVA of seed germination from samples collected from three vegetation zones in three Michigan wetlands after application of three sediment loadings.

Treatment	d.f.	MS ( $\times 10^3$ )	F	P	
Wetland	2	0.840	1.31	NS	
Vegetation Zone	2	2.668	4.18	0.02	
Sediment Loading	2	0.407	0.64	NS	
Wetland × Zone	4	10.0487	15.79	0.0001	
Wetland × Loading	4	1.552	2.43	NS	
Loading × Zone	4	2.151	3.37	0.02	
Wetland × Zone × Loading	8	0.743	1.16	NS	
Error	54	0.639			

TABLE 2: Mean number of seedlings emerging in the Eastern Michigan University greenhouse from seed bank samples from three zones within three Michigan wetlands after three sediment treatments (seedlings/kg sediment  $\pm$  S.E. (n = 3 except for grand means).

	Saline Wetland	Swift-Run Marsh	Waterloo Wetland		
Open Zone					
No Sediment	$24.6 \pm 4.4$	$83.4 \pm 6.7$	$130.0 \pm 61.0$		
Low Sediment	$43.4 \pm 15.4$	$120.0 \pm 22.7$	$67.4 \pm 14.5$		
High Sediment	$61.4 \pm 22.0$	$155.4 \pm 27.9$	$195.4 \pm 30.5$		
Grand Mean	$43.1 \pm 9.4$	$119.6 \pm 14.8$	$130.9 \pm 27.4$		
Sparganium Zone					
No Sediment	$269.2 \pm 84.1$	$79.2 \pm 17.9$	$22.0 \pm 9.0$		
Low Sediment	$180.0 \pm 27.1$	$76.0 \pm 33.6$	$33.4 \pm 6.4$		
High Sediment	$97.4 \pm 28.7$	$73.4 \pm 20.8$	$22.6 \pm 8.7$		
Grand Mean	$182.2 \pm 36.6$	$76.2 \pm 12.6$	$26.0 \pm 4.4$		
Typha Zone					
No Sediment	$53.4 \pm 38.5$	$68.6 \pm 27.7$	$82.6 \pm 33.4$		
Low Sediment	$20.6 \pm 3.5$	$107.2 \pm 21.1$	$36.0 \pm 13.1$		
High Sediment	$33.2 \pm 19.5$	$90.0 \pm 20.4$	$66.0 \pm 23.1$		
Grand Mean	$35.7 \pm 13.4$	$88.6 \pm 13.0$	$61.5 \pm 14.0$		

ent than germination from the *Typha* samples, but that germination was not statistically different between the open water and *Sparganium* samples.

Although the lowest germination occurred in samples from the *Typha* zone and the highest germination occurred in samples from the open water zone, when averaged for the three wetlands, this pattern was not representative of any individual wetland, i.e., P < 0.05 for the ANOVA interaction between wetland and sampling zone (Table 1). In the Saline wetland (Table 2), germination was highest in the *Sparganium* zone (182.2  $\pm$  36.6 seedlings/kg) and lowest in the *Typha* zone (35.7  $\pm$  13.4 seedlings/kg). Conversely, in Swift Run marsh and the Waterloo wetland, germination was highest in the open water zone (119.6  $\pm$  14.8 and 130.9  $\pm$  27.4 seedlings/kg respectively) and lowest in the *Sparganium* zone (76.2  $\pm$  12.2 and 26.0  $\pm$  4.4 seedlings/kg respectively—Table 2).

The vegetation sampling zones also differed significantly in their germination response to sediment loading (Table 1 – vegetation zone × sediment treatment). Between the control and low sediment loading treatment, germination was decreased 3.0%, 21.9%, and 19.9% for the open water zone, Sparganium zone, and Typha zone respectively, for the three wetlands combined (Table 2). However, differences between the control group and high sediment loading treatment showed a 73.3% increase for the open water zone, a 47.9% decrease for the Sparganium zone, and a 7.5% decrease for the Typha zone (Table 2). In other words, germination from open water samples was less affected under the low sediment application and perhaps stimulated by high sedimentation application. Conversely, both sediment loadings resulted in declines in germination from the zones dominated by emergent vegetation.

Sediment loading had no overall statistical effect on germination. Additionally, neither the ANOVA interaction between loading treatments and germination response by wetland nor the 3-way ANOVA interaction between sediment loadings, wetlands, and vegetative zones was significant (Table 1). But, the degree of variation in response to sediment loading between the three wetlands was surprising (Table 2). The Saline wetland demonstrated decreasing germination with increasing sediment loading while sediment loading in Swift Run marsh showed consistently increased germination (as averaged over all zones—Table 2). The germination response to loading in the Waterloo marsh was variable, i.e., a 41.7% decrease under the low loading treatment and a 21% increase under the high loading treatment when averaged over the three vegetation zones.

## DISCUSSION

Relative to reported sedimentation rates in undisturbed wetlands, the sediment loadings in this experiment (1 to 2.5 cm) were extreme. For example, the highest sedimentation rate reported by Walker (1970) in undisturbed wetlands was only 0.3 cm/yr. Given the magnitude of our sediment loadings, we assumed that two negative effects might be possible: (1) seedling emergence from the substrate might be delayed and (2) total germination from the seed bank could be reduced. With regard to the first expectation, our data suggested only a slight delay in the time to reach maximum total germination (Fig. 1); however, such delays can be important. In a competitive situation, the timing of establishment is critical to the success of a seedling. Early establishment can allow a plant to pre-empt resources prior to the emergence of other seedlings (Harper 1977). With regard to the second expectation, an overall statistically significant sedimentation effect was not detectable (Table 1).

To compare our treatments to undisturbed conditions may not be reasonable. Sampling of sediment, transport of samples to the lab, mixing of samples before placement in trays, etc. obviously suggests very high disturbance of the samples. Most studies of wetland seed bank dynamics have been conducted in greenhouse studies under conditions not dissimilar to this study; however, extrapolation of greenhouse results to field conditions must be done with care. Evaluation of sedimentation effects in particular should probably be done under field conditions or with an experimental protocol designed to minimize disturbance to samples. Typically, dormancy in wetland seeds seems enforced by darkness or low redox potentials and some disturbance of sediments is needed to expose seeds to conditions more favorable for germination. Cook (1980) reported that disturbance of the soil in forested areas would bring about germination of plant species from earlier stages of succession, e.g., Juncus tenuis Willd. Smith and Kadlec (1983) found that disturbances to the substrate surface would increase germination of many wetland species. Similarly, Haag (1983) reported a slight enhancement of germination by mixing of sediments which exposed the seeds to greater amounts of oxygen and light. Baskin et al. (1989) have demonstrated that the seeds of some perennial wetland plants have an absolute light requirement for germination. On the basis of these studies and given that suspended particles usually settle without disturbance or exposure of the seed bank under natural conditions, our failure to observe a statistically significant overall effect of sedimentation on seed germination may be related to a stimulatory effect of sample disturbance exceeding any inhibitory effect of sedimentation, assuming, of course, that an expectation for sedimentation to inhibit germination is even reasonable.

In a recent evaluation of the seedling emergence method as a means of determining seed bank composition (Poiani & Johnson 1988), this method was found to consistently underestimate seed abundance per unit weight of sediment and perhaps particularly so for open water species. However, seedling emergence was found to be a reasonably accurate predictor of rank order abundance for individual species. On the basis of these observations (Poiani & Johnson 1988), we believe that our values are probably underestimates of true seed densities in the sediments of the different wetlands and vegetation zones, but that the seedling abundance should be an accurate indicator of the rank order of seed abundance between the sample zones within each wetland. With this in mind, we can reasonably say that no clear relationship existed between seed abundance and vegetation zone across all wetlands (significant wetland × zone interaction – Table 1), e.g., total germination was highest in the Sparganium zone in the Saline marsh, but highest in the open water zone for the Waterloo and Swift Run marshes. Similarly, the lowest germination in the Saline marsh occurred in the Typha zone, but the lowest germination in the Waterloo marsh and Swift Run marsh occurred in the Sparganium zone. The higher germination from the open water zone in Swift Run marsh and the Waterloo wetland may in some way be related to the overall size of this zone in the three wetlands. Surface areas for the Saline wetland, Swift Run marsh, and the Waterloo wetland are approximately 2, 3, and 4 hectares, respectively, with the greatest percentage of open water occurring in Swift Run marsh and the Waterloo wetland. Preliminary counts of seed densities at Swift Run marsh suggest that seed densities in the top 5 cm of marsh sediment are 3 times greater in the open water zone than in the vegetation zone (Wiler 1988).

van der Valk and Davis (1976) observed that the seed banks from different vegetation types of the same marsh are more similar than between seed banks from the same vegetation type in different marshes and recommended that caution must be taken when using data from different marshes to predict generalized wetland responses, particularly to drawdowns. Our patterns of germination suggest that this observation also applies to total seed abundance, or at least total seed germination (significant wetland × zone interaction—Table 1). The overall similarity between the seed banks of various zones in a wetland is probably related to random seed distribution throughout the wetland since nearly all seeds of aquatic plants float or are wind dispersed (van der Valk and Davis 1976). Considering the overall variation between the seedbanks of vegetation zones in different wetlands,

it seems reasonable to assume that the effects of sedimentation on the seed bank in different vegetation zones might not be predictable between different wetlands. Consequently, any wetland restoration activity must give consideration to the amount of variation that exists in the seedbanks of different wetlands and caution must be exercised when applying data from other sites.

In their evaluation of the seedling emergence method, Poiani & Johnson (1988) did find the technique to be a reliable indicator of the floristic composition of seed banks. Qualitative differences with regard to germination of individual species were not determined in our study because few plants survived to maturity for identification. Polygonum lapathifolium L., Rorippa palustris var. hispida (Desv.) Rydb. and Sparganium eurycarpum were the only plants that were identifiable. Obviously, however, sedimentation will probably not affect all species equally. Determining the seedling recruitment response of individual species to sedimentation will probably be more important for wetland management, restoration, and creation than being able to predict a generalized seedling response to sedimentation.

## CONCLUSIONS

The data presented herein suggest that sedimentation slows seedling emergence and may possibly reduce seedling numbers in vegetation zones of particular wetlands. Variation in seed banks among vegetation zones within a wetland, however, may result in a range of germination responses to sedimentation among sites. Before the complete significance of sedimentation effects on seedling recruitment can be understood, further work is needed under undisturbed conditions (1) to further assess the factors which affect the sensitivity of particular wetlands and/or vegetation stands to sedimentation, (2) to determine the germination response of individual species to sedimentation, and (3) to determine the effects of sediment with different chemical and texture properties.

## **ACKNOWLEDGMENTS**

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## **OBITUARY**

Emanuel D. Rudolph (1927-1992)

Dr. Emanuel D. Rudolph, Professor Emeritus of the Department of Botany at The Ohio State University, died on 22 June 1992 at University Hospital in Columbus, Ohio.

Professor Rudolph was born 9 September 1927 in New York City. He received a B.A. in Biology from New York University in 1950 and a Ph.D. in Botany from Washington University at St. Louis, Missouri in 1955.

His college teaching career began in Wellesley College, where he taught biology from 1955 until 1961. From 1961 until his death, he was a member of the faculty of the Department of Botany at The Ohio State University. He retired in 1989 as Professor Emeritus but continued to teach one course each year at OSU and continued to serve as one of the curators of the OSU Herbarium.

Dr. Rudolph was an acknowledged expert in two areas, lichenology (especially those found in Antarctica; the genus *Edrudia* is named after him) and the history of botany. His contributions in the latter area include major articles on the history of women in botany, the history of the Missouri Botanical Garden, and the popularization of botany. He and his wife, Ann Waterman Rudolph (1934–1991), amassed a personal collection of over 50,000 books, many being rare early botanical works. This valuable collection has been given to the OSU Library with the botanical and horticultural works now forming the core of the library at the new OSU Herbarium. The Emanuel D. and Ann W. Rudolph Memorial Library Room was dedicated at the OSU Herbarium on 21 May 1993.

The Ohio State University has established the Rudolph Fund to provide scholarships in botany. Contributions may be sent c/o Anne Kochman, Dean's Office, College of Biological Sciences, 484 W 12th Ave, Columbus, OH 43210.

-- Richard K. Rabeler

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# HABITAT AND ECOLOGY OF IRIS LACUSTRIS (THE DWARF LAKE IRIS),

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## **ABSTRACT**

The threatened dwarf lake iris, *Iris lacustris* Nutt., is restricted to the northern shores of lakes Michigan and Huron. This study describes *Iris lacustris* habitats and identifies the effects of selected environmental factors on *Iris* populations. Light, soil, and *Iris* population measurements were taken for 198 plots from nine locations. Vegetation measurements from the plots were subject to DECORANA ordination and TWINSPAN classification. Regression and correlation analysis related soil factors and light intensity to *Iris* shoot, bloom, and fruit measurements and to DECORANA ordination scores. Blooms, fruits, and shoot density increased with increasing light intensity up to intermediate levels. At high levels, shoot density and blooms declined. Blooms, fruits, and shoot density also tended to decline with increasing soil O and A horizon depth. While *Iris* was observed to occur on a range of microsites, optimal *Iris* populations are associated with plots on thin, well drained soils that are semi-shaded but have enough light to support *Arctostaphylos uva-ursi*. Lakeshore disturbance and windthrow may be among the mechanisms maintaining this habitat.

## INTRODUCTION

The Dwarf Lake Iris, *Iris lacustris* Nutt., is listed as threatened by both Michigan (Beaman et al. 1985) and the Federal Government. While abundant on certain sites, its threatened status results from being restricted to the northern shores of Lake Huron and Lake Michigan and from the extreme development-pressure in these areas (Planisek 1983). Although this showy wildflower has received extensive publicity, little information about its ecology exists.

The limited literature suggests that *Iris lacustris* is often associated with shallow, calcareous soils in small openings in forests containing *Thuja occidentalis*. An investigation of label data from specimens at the Michigan State University herbarium revealed that the dominant woody vegetation for these specimens varied from *Populus tremuloides* to *Pinus resinosa* to *Thuja occidentalis*. Trick and Fewless (1984) reported that in Brown County, Wisconsin, the most common herbaceous associates were *Polygala paucifolia* Willd. and *Pedicularis canadensis* L. Makholm (1986) described

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I. lacustris as occurring within a wide range of both soil and light conditions.

Once established, dwarf lake iris can vigorously colonize lightly shaded sites asexually through annual forking and growth of rhizomes. Trick and Fewless (1984) reported that *Iris lacustris* had successfully invaded both old logging roads and the rights-of-way of active roads. Planisek (1983) reported clones expanding vegetatively out of *Thuja occidentalis* woodlands into disturbed sites.

Sexual reproduction, in contrast, is limited. Low fruit production may contribute to the rarity of *Iris lacustris* (Planisek 1983). Planisek determined that a pollinator was necessary for seed set and that pollination is the primary factor limiting fruit production. However, neither she nor other published investigators have identified a pollen vector.

The objectives of this study are to describe *Iris lacustris* habitats, to identify the effect of selected environmental factors on *Iris* populations, and to identify environmental characteristics and associated species typical of optimal *Iris* microsites: microsites that produce high numbers of shoots, blooms, and fruit.

#### **METHODS**

During the summer of 1988, nine *Iris lacustris* locations were sampled. Two herbaria (MSC, MICH) and the occurrence records of the Michigan Natural Features Inventory, Lansing, were consulted for study site selection. An attempt was made to sample throughout the geographic range of Michigan *I. lacustris* populations and from a range of habitat and soil types. The sites sampled included French Bay on Beaver Island, Charlevoix Co.; Indian Harbor on Garden Island, Charlevoix Co.; Wilderness State Park, Emmet Co.; Cheboygan State Park, Cheboygan Co.; Grass Bay, Cheboygan Co.; Thompson's Harbor State Park, Presque Isle Co.; Point Detaché, Bois Blanc Island, Mackinac Co.; Point Patterson, Mackinac Co.; and the Escanaba River near Cornell, Delta Co. Qualitative observations were made at four additional sites including a site near Koss, Menominee Co.; approximately 1.5 km west of the sample site at Point Patterson, Mackinac Co.; near Grape Island Spit on Hog Island, Charlevoix Co.; and Appleby's Point on Beaver Island, Charlevoix Co.

Random transects were established perpendicular to the shore or forest edge at each site. The area covered by *Iris lacustris* colonies was estimated using the line intercept method (Barbour et al. 1980). If the line passed within 10 cm of a ramet (an asexual offshoot) the colony was considered intercepted by the line. Each transect was continued in from the edge until no additional *I. lacustris* colonies were encountered. The mean percentage *Iris* cover for

each transect was calculated.

One-half m<sup>2</sup> plots were established on randomly selected intercepted colonies. At least 15 plots per site (198 total, Table 1) were placed randomly within a colony along the right side of the transect line. At Grass Bay, Indian Harbor, and French Bay, plot corners were permanently marked with PVC stakes. Between 4 June and 21 June, withered blooms in each plot were counted along with developing capsules according to Planisek (1983). During the first visit, plots at French Bay, Indian Harbor, Wilderness State Park, Cheboygan State Park, and Grass Bay had significant numbers of open or freshly withered blooms on which the ovaries had not begun to yellow or swell. These sites were revisited after 17 June and the capsules re-counted. The number of ramets was counted for each plot. The bloom to shoot (ramet) ratio, and the fruit to shoot ratio was also calculated. The ability of *Iris lacustris* to flower and fruit was interpreted as a possible indicator of vigor and reproductive success for a colony.

The percentage cover for each species in each plot was estimated. Raw cover estimates were transformed to an octave scale (Gauch 1982) prior to analysis. Nomenclature and taxonomy follows Voss (1972, 1985) where possible. Gleason and Cronquist (1963) was consulted for

TABLE 1. Number of transects and sample plots, Mean colony width (transect length) and Mean percentage of *I. lacustris* cover for the nine sampling locations. Ranges are 95% confidence intervals for the mean.

Location	Number of transects	Number of plots	Transect length (m)	Percentage cover		
French Bay	10	31	$31.9 \pm 6.3$	$30.0 \pm 2.8$		
Indian Harbor	6	20	$33.8 \pm 10.7$	$30.7 \pm 6.1$		
Wilderness State Park	7	20	19.1 ± 7.5	$27.6 \pm 5.5$		
Cheboygan State Park	6	20	$49.5 \pm 7.3$	$40.2 \pm 5.0$		
Grass Bay	6	30	$45.2 \pm 18.0$	$7.7 \pm 7.2$		
Thompson's Harbor	6	22	$66.6 \pm 21.1$	$40.2 \pm 7.0$		
Point Detaché	6	20	$43.0 \pm 9.1$	$19.7 \pm 4.1$		
Point Patterson	6	20	$33.7 \pm 10.0$	$35.8 \pm 4.6$		
Escanaba River	6	15	$26.6 \pm 9.4$	$38.4 \pm 6.0$		

species not covered in the Michigan Flora volumes. We used the point-quarter method (Barbour et al. 1980) for 20 random points along the plot transects to estimate tree densities, basal areas, frequencies, and importance values at each location.

The depth of the soil to unweathered parent material (generally the depth of the O and A horizons), the depth of undecomposed surface litter, and the type of soil parent material were recorded. A metal tube was used to determine if the water table was within 25 cm of the soil surface. Such plots were classified as wet, and the remaining plots as dry. A water table within 25 cm of the surface was believed to indicate saturated conditions in or near the *I. lacustris* rooting zone.

A General Electric model 201 hand-held light meter was used to measure light in the center of each plot at 10 cm above the soil surface on clear days. Beginning at 0830 hrs EDST, instantaneous light measurements were taken for each plot in a site. The last plot was measured within 30 minutes of the first plot. This procedure was repeated at 1100, 1300, 1500, and 1730 hrs EDST resulting in five measurements for each plot spanning most of the day. Mean light levels were calculated for each plot from these five observations. Measurements were also taken at each site for an area receiving full radiation all day long. These values were averaged for all nine sites, and used to standardize the plot averages from the various sites in terms of a standard, full-radiation day. Although the occurrence of random light flecks or shadows at the time of measurement may have skewed light readings on some of the plots, we believe that the large number of plots considered tend to "average out" such cases and minimize this problem.

A microcomputer database was developed for the field data using Dbase III<sup>+</sup>. We used the Number Cruncher Statistical System microcomputer program (Hintze 1990) for statistical analyses. Correlation analysis and multiple regression were used to relate *Iris lacustris* characteristics such as the bloom-to-shoot ratio to environmental variables such as light.

A multivariate ordination technique known as Detrended Correspondence Analysis (DECORANA, Hill 1979a), an improvement of reciprocal averaging ordination, was used to arrange sites along four axes on the basis of the presence and coverage of the understory species on each plot. Plots with similar species combinations are nearby in ordination space while dissimilar plots are separate. Since most of the relevant information in the ordinations for this study was included on the first two axes, ordinations were displayed as two dimensional scatter plots (e.g. Fig. 2).

Two Way Indicator Species Analysis (TWINSPAN), a divisive polythetic classification technique based on repeated division of a reciprocal averaging ordination space (Hill 1979b), was used to group plots into classes with similar species combinations and to identify the species important in differentiating these classes.

Stepwise multiple regression (Hintze 1990) was used to relate ordination scores to environmental variables and analysis of variance was used to compare characteristics of the Iris lacustris populations among the various TWINSPAN groups.



FIGURE 1. *Iris lacustris* habitat at French Bay on Beaver Island. *Iris lacustris* commonly occurs along the lakeshore on gravelly or sandy beach ridges in small gaps in *Thuja occidentalis* and *Abies balsamea* forest.

## RESULTS

With the exception of the site along the Escanaba River, and the Grass Bay site where *Iris lacustris* occured several hundred meters inland and was associated with the edge of a large inter-dunal wetland complex, the *Iris* populations sampled were located along lakeshores on sandy or gravelly beach ridges in areas previously disturbed by lakeshore erosion (Fig. 1). *Iris* colonies covered between 16 and 55 percent of the ground and extended no more than 90 m in from the forest edge for the nine sample locations (Table 1). Forest canopies were broken by small gaps which generally became more numerous closer to the beach. *Thuja occidentalis*, *Abies balsamea*, and *Picea glauca* dominated the overstory on most sites (Table 2). *Pinus strobus* was also important at Grass Bay and the Escanaba River, while *Pinus resinosa* dominated at Thompson's Harbor.

Soils at these sites were thin and poorly developed. A typical profile consisted of a layer of partially decomposed coniferous litter (O<sub>i</sub> and O<sub>e</sub> horizons) and a thin or nearly absent A horizon on top of a parent material composed of calcareous gravel, sand, or a mixture of the two. B horizon development was generally absent; most of the soils would be classified as entisols. In the most extreme cases, open areas near the beach on recently formed beach-ridges, the soil was a thin crust of organic material on top of

TABLE 2. Importance values (in percent) based on density, frequency, and basal-area for tree species sampled for nine *Iris lacustris* sites. FB = French Bay, IH = Indian Harbor, WS = Wilderness State Park, CS = Cheboygan State Park, GB = Grass Bay, TH = Thompson's Harbor, PD = Point Detaché, PP = Point Patterson, and ES = Escanaba River.

Species	Location								
	FB	IH	WS	CS	GB	TH	PD	PP	ES
Abies balsamea (L.) Miller	26.5	24.3	35.6	9.5	6.2	2.6	10.2	12.6	8.2
Alnus rugosa (Duroi) Sprengel	0.0	0.0	0.0	0.0	2.4	0.0	0.0	0.0	0.0
Betula papyrifera Marshall	1.6	5.6	10.8	3.2	3.1	5.7	0.0	5.0	0.0
Larix laricina (Duroi) K. Koch	0.0	5.3	0.0	0.0	6.8	0.0	13.3	0.0	0.0
Picea glauca (Moench) A. Voss	38.9	3.8	11.9	8.2	8.2	0.0	9.5	36.0	15.9
Pinus resinosa Aiton	0.0	0.0	0.0	0.0	2.5	48.2	0.0	0.0	0.0
Pinus strobus L.	0.0	0.0	0.0	5.6	28.0	0.0	4.6	0.0	35.0
Populus tremuloides Michaux	0.0	5.3	4.9	2.2	0.0	5.0	0.0	0.0	14.3
Salix sp.	0.0	2.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Thuja occidentalis L.	33.0	50.5	36.8	66.5	42.8	38.5	62.4	46.4	35.0

unweathered parent material. The only exception was the Escanaba River, where *Iris lacustris* grew in a deep soil formed in loess over limestone.

One hundred forty-four woody and herbaceous species were encountered on the 198 sample plots. A DECORANA ordination of plots based on these species identified four vegetation types associated primarily with soil parent material (Fig. 2). The first group includes 28 plots with sandy soils predominantly from Grass Bay. Plots in this group, while generally in low-lying areas, occurred on both wet and dry situations, and commonly included *Vaccinium angustifolium* Aiton, *Vaccinium corymbosum* L., *Linnaea borealis* L., and *Equisetum arvense* L.

Plots with deep soils formed in loess over limestone occurred at the Escanaba River and were commonly associated with *Poa compressa* L., *Pteridium aquilinum* (L.) Kuhn., *Trillium grandiflorum* (Michaux) Salisb., and a coarse, cespitose, *Carex* species not encountered elsewhere in the study. Four plots occurred in a boggy-forest situation at Point Detaché and were associated with *Carex leptalea* Wahlenb. and *Sphagnum* sp.

Plots on mainly gravelly and mixed sand-gravel sites associated with the beach-forest edge habitat typical of *Iris lacustris* composed the majority of the data set. These 153 plots were ordinated separately in order to clarify the trends within this group (Fig. 3). A multiple linear regression of environmental variables on DECORANA axis 1 for these plots indicates that axis one scores increased with increasing light and decreasing litter depth.  $R^2$  is 0.60 (p<0.01) and light and litter account for 58 and 2 percent of the variance respectively. DECORANA axis 2 was weakly associated with soil depth ( $r^2 = 0.1$ , p<0.05) and axes three and four were not significantly related to any of the measured variables.

Four vegetation types were identified by TWINSPAN for these 153 plots (Fig. 3). Groups one and two were associated with low axis 1 scores and therefore, shaded conditions, and contain *Polygala paucifolia* and *Linnaea* 

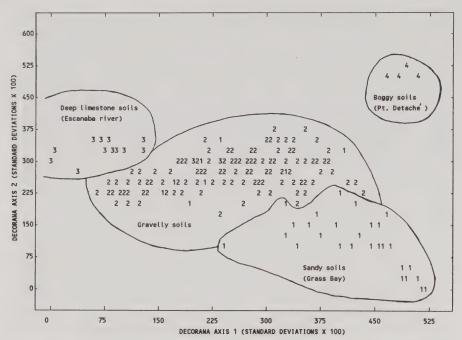


FIGURE 2. A DECORANA ordination of 198 *Iris lacustris* plots. Numerals represent 1) sandy, 2) gravelly, 3) loess over limestone, and 4) boggy soil types. The two axes represent 75% of the summed eigenvalues. Lines aid visualization of the clusters but have no statistical basis.

borealis. TWINSPAN further divided this group into plots in which Abies balsamea seedlings and high coverage of Polygala paucfolia are common (group 2) and plots associated with Viola spp., Aster macrophyllus L., and Taraxacum officinale Weber (group 1). Viola-Aster type plots were often observed in small windthrow openings in older portions of the forest away from the beach.

Groups three and four (Fig. 3) consisted of more open plots and usually contained *Arctostaphylos uva-ursi* (L.) Sprengel. This group can be divided into a species-poor type not consistently associated with any additional indicators (group 3), and a group associated with *Andropogon scoparius* Michaux, *Comandra umbellata* (L.) Nutt., and *Carex aurea* Nutt. (group 4). Many plots in group 4 occurred in an open meadow at Cheboygan State Park.

Soil differences influenced the *Iris lacustris* populations. Plots with a water table within 25 cm of the surface had a significantly lower bloom-to-shoot ratio (p < 0.01) than dry plots (Table 3). Plots with a gravelly parent material (not to be confused with the predominantly gravelly vegetation type previously identified) tended to have a higher bloom ratio (only marginally significant at p = 0.052) than sandy plots but had a significantly

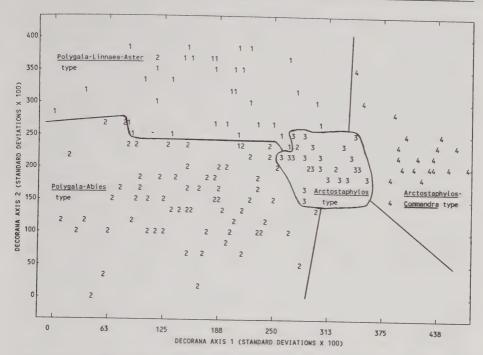


FIGURE 3. A DECORANA ordination of 153 *Iris lacustris* plots on predominantly gravelly parent material. Numerals and labels represent four vegetation types derived from a TWINSPAN classification. The two axes represent 80% of the summed eigenvalues. Lines aid visualization of the clusters but have no statistical basis.

lower fruit to shoot ratio (p<0.05, Table 3). Gravelly sites also had a significantly higher bloom ratio than the Escanaba River sites with deep limestone soils (p<0.05). Increasing bloom-to-shoot ratios were also weakly correlated with decreasing litter depth (r = -0.30, p<0.01) and thinner soils (r = -0.36, p<0.01). At high light levels (>3800 FC), the negative correlation between the bloom-to-shoot ratio and soil depth became strong (r = -0.71, p<0.05). The fruit to shoot ratio was also weakly correlated with decreasing soil depth (r = -0.30, p<0.01) and with

TABLE 3. Mean bloom-to-shoot ratio, fruit-to-shoot ratio, and significance of comparison for wet, dry, sandy, and gravelly soil types. (NS = p > 0.5).

	Wet	Dry	Significance
Bloom ratio	0.033	0.076	p<0.01
Fruit ratio	0.011	0.018	NS
	Sandy	Gravelly	Significance
Bloom ratio	0.054	0.076	p<0.52
Fruit ratio	0.027	0.015	p<0.05

litter depth (r = -0.29, p<0.01). Shoot density was likewise weakly correlated with shallower soils (r = -0.17, p<0.05) and thinner litter (r = -0.25 p<0.01).

Light levels also influenced *Iris lacustris*. Increasing light levels were weakly correlated with a higher bloom-to-shoot ratio (r = 0.35, p < 0.05). Figure 4, however, reveals that the bloom ratio actually declines with increasing light beyond approximately 3800 foot candles (FC). Taking the logarithm  $_{10}$  of light partially compensates for this effect; the correlation increased to 0.47 (Table 4).

At levels below 3800 FC, light (r=0.45) and log light (r=0.47) were positively correlated with the bloom-to-shoot ratio (Table 4). Moreover, most of the sites with a zero bloom-to-shoot ratio and light levels between 1500 and 3000 FC (Fig. 4) were wet plots at Grass Bay where *Iris lacustris* grew in thickets of *Carex stricta* Lam. under a broken forest canopy. Trampling associated with sampling on these plots caused much of the *Carex stricta* to lodge and light levels to be greatly overestimated. Also, wet plots in general are associated with fewer blooms (Table 3). When wet sites were excluded from the data set, the correlation between light and the bloom ratio for sites illuminated with less than 3800 FC increased to r=0.53 (Table 4). A negative correlation (r=-0.66) between the bloom-to-shoot ratio and light existed for plots with light intensities of greater than 3800 FC (Table 4).

A multiple regression model for dry plots predicted the bloom-to-shoot ratio on the basis of light and soil depth: Bloom/shoot = -.104 + 0.0304 log light -0.0028 soil depth.  $R^2 = 0.37$ , p<0.01, and light and soil depth explain 30 and 7 percent of the variation respectively.

The fruit-to-shoot ratio was weakly positively correlated with light and log light at light levels of less than 3800 FC. The fruit ratio declined at light levels greater than 3800 FC (r = 0.48) but with only 14 degrees of freedom, the correlation was only significant at the p = 0.06 level (Table 4).

Shoot density was also affected by light levels. Like blooms and fruits, shoots declined at the highest light levels (Table 4). A very weak positive correlation between shoots and light levels existed on plots receiving less than 3800 FC (Table 4). However, an analysis of variance also revealed that significantly fewer shoots occurred on the most shaded plots (light < 500 FC) than on the remainder of the plots (F = 5.9, p < 0.02).

No significant differences were observed in *Iris lacustris* bloom ratios, shoots, or fruit among the four vegetation types identified in Figure 2. However, among the subdivisions of the main type, the 153 chiefly gravelly plots (group 2 in Fig. 2), the bloom ratio was significantly related to vegetation type (F = 3.6, p < 0.016). Vegetation type 3 of Figure 3, lightly shaded plots with *Arctostaphylos uva-ursi*, had a significantly higher bloom ratio than the shaded plots containing *Linnaea* and *Polygala* (Groups 1 and 2, Fig. 3). The mean bloom ratio was also higher than that of group 4 (open plots with *Andropogon scoparius*), but the Duncan's Range test comparison was not significant (Fig. 5A).

A similar pattern occurred for fruit (F = 5.1, p < 0.002); the open Arcto-

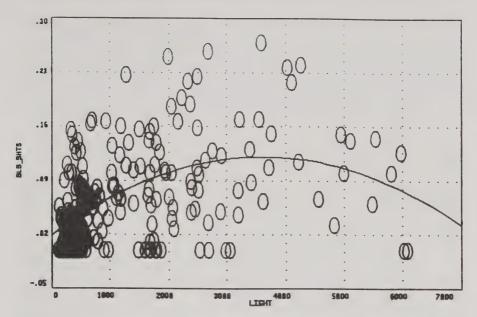


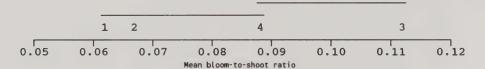
FIGURE 4. The relationship between the bloom-to-shoot ratio and light (foot candles) for *Iris lacustris*. The ratio increases with increased light up to approximately 3800 FC. At higher light levels the ratio declines. A second-order polynomial curve which approximates this relationship is fitted to this graph.

staphylos type plots (groups 3 and 4, Fig. 3) had a significantly higher fruit-to-shoot ratio than the shaded *Polygala-Linnaea* plots (Fig. 5B). Since these vegetation types and DECORANA axis 1 were strongly related to light levels, the pattern observed here probably reflects the previously reported pattern observed between light levels and blooms, shoots, and fruits.

TABLE 4. Correlations of the logarithm of light and untransformed light in foot candles (FC) with the bloom-to-shoot ratio, the fruit ratio, and the number of shoots in *Iris lacustris* plots. Correlations are for the entire data set, plots receiving a mean of less than 3800 FC, and for plots receiving more than 3800 FC. (\*\* = p < 0.01, \* = p < 0.05, NS = p < 0.06)

Correlations	r (log light)	r (light)
Bloom/shoot (entire data set)	0.47**	0.35**
Bloom/shoot (plots < 3800 FC)	0.47**	0.45**
Bloom/shoot (dry plots < 3800 FC)	0.57**	0.53**
Bloom/shoot (plots > 3800 FC)	-0.67**	-0.66**
Fruit/shoot (plots < 3800 FC)	0.37**	0.35**
Fruit/shoot (plots > 3800 FC)	-0.49 NS	-0.49 NS
Shoots (plots < 3800 FC)	0.19*	0.16*
Shoots (plots > 3800 FC)	-0.68**	-0.67**





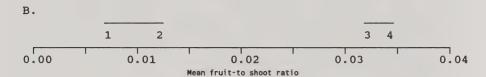


FIGURE 5. Mean bloom-to-shoot ratios and fruit-to-shoot ratios of *Iris lacustris* plots for four vegetation types based on TWINSPAN. Bars connect pairwise comparisons not significant at the p<0.05 level by Duncan's Multiple Range test. Numerals refer to the vegetation types identified in Figure 3: (1) shaded, *Polygala-Linnaea-Abies*, (2) shaded, *Polygala-Linnaea-Viola*, (3) somewhat open, *Arctostaphylos* and (4) open, *Arctostaphylos-Commandra*.

#### DISCUSSION

The data demonstrate that once established, *Iris lacustris* occurs over a rather wide range of microsite types. Soils in *Iris* habitats varied from wet and sandy at Grass Bay, to loess over limestone at the Escanaba River, to gravel or mixed sand and gravel beach ridges at the majority of sites. Soil pH in *I. lacustris* plots has also been observed to range widely, from 5.4 to 7.5 (Van Kley 1989). Various light and soil moisture conditions were also encountered on the sample plots.

Iris lacustris also occurs on a broader range of microsites than most of the other species associated with it. Only ten species occurred in more than 25 plots; no species was represented in greater than 41% of the plots. Only mature Abies balsamea and Thuja occidentalis were routinely associated with I. lacustris. Even here there are exceptions: observations at a site near Koss, Michigan (Menomenee County) revealed a predominantly Quercus-Populus overstory. Likewise, Makholm (1986) reported the occurrence of I. lacustris on sites dominated by hardwoods.

Despite occurrence over a range of habitats, *Iris lacustris* shows preference for certain types of microsites. Plots with intermediate light levels, thin, young soils, and a non-surface water table tend to produce high numbers of blooms and fruits and may represent optimal microsites. These microsites may be associated with the *Arctostaphylos-Commandra* vegetation type (Fig. 3) which had significantly higher bloom and fruit ratios than the two more shaded plot types.

Since vegetation can integrate many site factors (Daubenmire 1980),

associating populations of rare species with microsite vegetation types by use of such tools as TWINSPAN and DECORANA is potentially valuable to investigators and managers. Although ordination and classification have been used extensively for ecological classification (Girrard et al. 1989, Van Lear & Jones 1987), and for describing plant communities along ecological gradients (Gauch 1982), we are unaware of many studies in which these methods were used to identify optimal microsite vegetation types for rare species.

Of the environmental factors considered, light affected *Iris lacustris* the most. At the lowest levels, indicative of a nearly closed canopy, most plots had reduced shoot densities and few fruits or flowers (Fig. 4). In this respect, *I. lacustris* has the same response to canopy disturbance as several other perennial understory herbs (Pitelka et al. 1980, Winn & Pitelka 1980, Thompson 1981, Dahlem and Boerner 1987). Many understory perennials under an intact canopy grow slowly and reproduce exclusively by vegetative propagation.

Iris lacustris also experienced reduced bloom and fruit density at the highest light levels (Table 4). Shoot density was likewise lower. There may be two sources for this effect. First, colonies in the open may suffer periodic die-back because of drought and water stress. During July and August of 1988, one of the hottest and driest summers on record, we observed substantial mortality in the most open portions of nearly every location we visited. Second, the open areas may be areas that were relatively recently created by lake shore or other disturbances. Many of the colonies from open areas were so small that they failed to fill the 0.5 m² plot, resulting in a low density measurement even though the ramet density within the colony was rather high. Since I. lacustris has an inefficient breeding system (Planisek 1983), and often is restricted to growing a few centimeters a year by vegetative propagation, such colonies may not have had enough time to fully occupy open sites since the last disturbance event (or since the last severe drought).

Since light is important to *Iris lacustris*, a logical management strategy for this species would be to create or enlarge canopy openings. However, more precise knowledge of the threshold (3800 FC in this study) where more light becomes detrimental to *Iris* as well as information on how the duration of exposure to high light levels affects colonies is needed. More precise techniques, such as simultaneously and continuously measuring light in a number of plots over a period of time with a quantum sensor connected to a data logger are necessary.

Iris lacustris populations also respond to soil characteristics. Iris colonies tend to decline as litter, O horizon, and A horizon depths increase. Although light and soil depth were only weakly correlated in this study (r = 0.23), reduced blooming, fruiting, and ramet density on deeper soil may partly result from lower light levels on older soils in portions of the land-scape that were undisturbed long enough for forest trees to fully colonize the site. Also, better developed soils may support other herbaceous species which, given enough light, will out-compete Iris lacustris. Evidence for this

claim comes from the strong negative correlation (r = -0.71) observed between the bloom-to-shoot ratio and soil depth at high light levels.

Two general explanations exist for the reduced flowering observed on plots with a water table within 25 cm of the surface. Lack of oxygen, changed mineral availabilities, and toxic by-products associated with anaerobic conditions may reduce *Iris lacustris* vigor. Second, most wetlands, given enough light, support a profusion of herbaceous species with which *I. lacustris* may not readily compete. Many of the wet plots at Grass Bay, for example, were dominated by dense stands of *Carex stricta* which overtopped *I. lacustris*.

Results comparing sandy and gravelly plots in this data set are somewhat contradictory; fewer blooms but more fruits per shoot were observed on sandy plots. Observations of three additional sandy locations on Hog Island, Appleby's Point on Beaver Island, and Point Patterson west of the sample site also indicated high numbers of fruit in lightly shaded locations. More fruiting on sandy plots could be related to pollinator habitat preferences or other aspects of *Iris lacustris* pollination biology. Large, active, open sand dunes, characteristic of much of the southern shores of Lake Michigan, however, are likely to be extremely xeric and inhospitable to *Iris*.

Further comparison of *Iris lacustris* populations on sandy and gravelly sites is needed. Investigations into other soil dynamics such as allelopathy, soil temperature, the nutrient requirements of *Iris*, differences in colonies growing on coniferous duff and on mineral soil, and soil conditions favoring seed germination may also answer some of the soil questions raised in this study.

Lakeshore disturbance in the form of wave action, ice scouring, fluctuating water levels, and wind damage to the adjacent forest edge may help maintain the openings, small trees, and thin soils essential for *Iris lacustris*. The ecology of *I. lacustris* in lake front locations therefore may involve a balance between lakeshore disturbance and forest succession. Lakeward portions of all but the two inland *I. lacustris* populations observed in this study had evidence of erosion, washing, and the uprooting of trees resulting from the high water period ending in 1987. Also, for each of these populations, the largest openings, smallest trees, and thinnest soils were generally observed along the lakeshore edge of the forest.

These dynamics may contribute to the predominantly lakeshore distribution of *Iris lacustris*. Elsewhere, especially before European settlement, extensive openings and edges with thin soils may not have persisted long enough to permit colonization by Iris, which is limited in its fecundity (Planisek 1983). Lakeshore openings and edges are more permanent and primary forest sucession on fresh beach ridges is slow, providing ample time for colonization.

The exact nature of the disturbance regime deserves more detailed investigation. How do the beach ridges commonly associated with *Iris lacustris* form? How long before they succede to closed canopy forest? Do these processes take place on the time scale of centuries or millenia? Does ice scouring affect *Iris* populations? Do fluctuating Great Lakes water levels

serve to re-set forest succession and create new habitat? What other disturbance regimes can maintain habitats, particularly for inland populations?

In conclusion, while the habitat specificity of established *Iris lacustris* colonies is rather broad, optimal *Iris* populations are associated with microsites on thin, well drained soils that are semi-shaded but have enough light to support *Arctostaphylos uva-ursi*. Limitations of the breeding system and dispersal (Planisek 1983) and poor seed germination in *Evansia* irises (Köhlein 1989) may be major reasons for the rarity of *I. lacustris*. Limited areas of optimal lightly-shaded habitat with thin soils may further restrict *Iris*.

Despite a preference for a somewhat disturbed habitat, *Iris lacustris* will not grow where the habitat has been destroyed by residential, resort, and industrial development. Unfortunately, this appears to be the fate of much of Michigan's shoreline. Only if we protect our state's few remaining undeveloped coast lands can we assure that this splendid wildflower, the dwarf lake iris, will grace the shores of the future as it has graced the shores of the past.

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### ANNOUNCEMENT

## MICHIGAN BOTANICAL FOUNDATION

It is a pleasure to welcome the *Michigan Botanical Foundation* into existence. It is incorporated under the laws of the State of Michigan and has received its tax-exempt status as an I.R.S. 501 (c)(3) organization.

The Michigan Botanical Foundation was created to enable individuals, groups, companies—anyone—to make tax-deductible donations and arrange bequests in support of botanical activities in Michigan. As funds accumulate, the MBF will make grants to individuals and organizations in support of botanical projects, field trips, lectures, publications, and other plant-related activities within the State of Michigan.

The Board of Directors of the new foundation include: Elwood B. Ehrle, Western Michigan University, President; Dorothy McMeekin, Michigan State University, Vice-President; Dennis Woodland, Andrews University, Treasurer; Anton A. Reznicek, The University of Michigan, Director; and Julie Medlin, Northwestern Michigan College, Director.

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# CAREX HETEROSTACHYA, THE CORRECT IDENTITY OF C. ×FULLERI (CYPERACEAE)

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The putative hybrid  $Carex \times fulleri$  Ahles in Fell was described from specimens collected from 1949 to 1954 from a single patch on the crest of a dry,  $\pm$  open gravel bluff on a former military base (Camp Grant) in Winnebago County, Illinois (Fell 1956). The habit of the plant was reminiscent of a large, stout, somewhat wide-leaved C. pensylvanica Lam., and the suggested parents were C. laeviconica Dewey and C. pensylvanica. It was also speculated that the plant might have been accidentally introduced through military activity.

The suggested parentage of Carex × fulleri was neither supported by data nor discussed, and seemed quite improbable as these two species are very different morphologically. Carex × fulleri possesses several features that are not intermediate, including brown bladeless basal sheaths, leaves papillose beneath, and strongly thickened perigynium walls. In contrast, both proposed parents have reddish-purple basal sheaths, leaves smooth beneath, and thin-walled perigynia. Carex × fulleri lacks true vegetative culms, but a hybrid involving C. laeviconica should possess them (Reznicek & Catling 1986). Carex × fulleri has glabrous perigynia, but a hybrid involving C. pensylvanica should have at least sparsely pubescent perigynia. Carex meadii Dewey, which was the other species implicated as a possible parent by Fell (1959), has leaves papillose beneath and glabrous (but papillose) perigynia; in C. × fulleri, however, the perigynia are essentially smooth. The perigynium walls of C. meadii are not thickened as they are on C. × fulleri. Thus, C. meadii also can be ruled out as a possible parent.

Carex pensylvanica also flowers much earlier than C. laeviconica. In the Chicago region, flowering dates for C. pensylvanica ranged from 6 April to 13 May. The few specimens of C. laeviconica at MICH and MOR that were at anthesis were collected between 6 June and 14 June, but the closely related C. trichocarpa, which flowers at essentially the same time, had flowering dates in the Chicago region ranging from 18 May to 18 June (unpub. data supplied by G. Wilhelm).

Although fruiting is apparently uncommon and erratic, Carex × fulleri does sometimes produce normal achenes, contrary to Fell (1956). An intersectional hybrid of such disparate putative parents, however, would almost certainly be absolutely sterile, at least for achene production (Cayouette & Catling 1992). A hybrid origin, therefore, seemed very unlikely, and the partial sterility of this population was possibly due to the plant being partially self-incompatible and the occurrence being a single clone. Though

little is known about the breeding biology of C.  $\times fulleri$ , sterility of single clones of self-incompatible species of Carex is well known (Ford et al. 1991).

But what is the identity of Carex fulleri if not a hybrid? Several features visible on good, recent collections of this plant, including the persistent,  $\pm$  bony, proximal portion of the style; coriaceous, ovoid perigynia; and  $\pm$  erect, short-cylindric spikes, suggested that it belongs to Carex section Paludosae G. Don. While most native North American species of section Paludosae are large, usually wide-leaved, wetland plants, many Asian species are smaller, narrower leaved, and occur in dry habitats. Carex fulleri turns out to be a precise match for C. heterostachya Bunge, a frequent species of dry, open habitats in China and Korea. Clinching diagnostic features of C. heterostachya include the narrow leaves, papillose beneath; primarily cinnamon-brown rather than purplish-red basal sheaths; and smooth, short (3.1-4.5 mm long), broadly ovoid, essentially nerveless perigynia. The name C. fulleri must be added to the synonymy of C. heterostachya provided by Ohwi (1936).

No other occurrences of Carex heterostachya are known in North America, although two other narrow-leaved Eurasian members of Section Paludosae are known as sporadic introductions; C. pumila Thunb. (Reznicek 1993) and C. melanostachya Willd. (McGregor et al. 1972; an earlier report of this species, under the name C. nutans Host (Marie-Victorin 1929), was based on poor specimens of uncertain identity but possibly of hybrid origin (Boivin 1992, Cayouette & Catling 1992)). Carex heterostachya was presumably introduced from Asia, probably by military activity during World War II since the first collection was shortly after the end of the war in 1949. At that time, the patch (presumably a single clone) was already quite large (Fell 1956), indicating that it had been established at least several years.

A comprehensive description of *Carex heterostachya* is provided here as a ready reference, since existing descriptions are either very brief or written in a language other than English. *Carex heterostachya* is apparently a ruderal in Asia, and could very well occur elsewhere in North America. The Illinois colony has persisted and spread vegetatively for over 40 years, so the species is quite able to survive in North America. A good illustration of *C. heterostachya* is plate 144 (Fig. 1) in Akiyama (1955).

Carex heterostachya Bunge, Enum. Pl. China Bor. 69. 1833.

Colonial, rhizomes long-creeping, ca. 1–3.5 mm thick, covered with persistent, brown, bladeless sheaths that rapidly disintegrate into fibers. Fertile culms ca. 25–60 cm long, trigonous, papillose, scabrous angled below inflorescences, central, with the previous year's leaves  $\pm$  persistent, bladeless basal sheaths cinnamon-brown, rapidly disintegrating into persistent fibers. Leaves 3–6, mostly on the lower third of the culm, blades ca. 8–40 cm long, 1.5–3.2 mm wide, plicate, finely antrorsely scabrous on the margins and midrib beneath, glabrous, faintly glaucous, finely papillose beneath; sheaths covering nodes,  $\pm$  tight, finely papillose, ca. 4–8 cm long, green to cinnamon-brown, the inner band whitish-hyaline to pale brown, finely

nerved and heavily reddish-brown dotted, sometimes finely antrorsely scabrous, the apex concave, thickened; ligules ca. 0.7-1.5 mm long, rounded to obtuse, the free portion thin, whitish-hyaline to pale brown, 0.2-0.5 mm long. Vegetative shoots ca. 40-75 cm tall, leaves 6-9, 20-65 cm long, 2-3 (-4) mm wide, tapering to long filiform tips; pseudoculms ca. 6-18 cm long. with bladeless basal sheaths cinnamon-brown to occasionally slightly reddened. Inflorescences 2.5-6 (-11.5) cm long, terminal spikes staminate, lateral spikes pistillate or occasionally the uppermost androgynous. Pistillate spikes (1-) 2-3 (-4), usually overlapping, ovate to short-cylindric, 0.8-2 cm long, 5-7.5 mm wide, ca. 10-30-flowered; peduncles erect, scabrousangled and finely papillose, the lowermost up to 1.1 cm long, the upper spikes sessile; lowermost bracts with blades 1.5-5 (-11) cm long, 0.9-2.5 mm wide, essentially sheathless, the upper bracts much reduced. Staminate spikes 1 (-2), ca. 1.5-2.8 cm long, 1.5-3 mm wide, ca. 30-80-flowered, bractless, peduncle 0.2-1 (-4.2) cm long; lateral staminate spikes, if present, much smaller. Pistillate scales 2.7-4.9 (-5.5) mm long, 1.8-2.8 mm wide, ovate to broadly ovate, acute to acuminate-awned with an awn up to 1.3 mm long, reddish-brown with a ± papillose, pale green to pale brown center, sometimes with narrow hyaline margins, 3 (-5)-nerved. Staminate scales 3.8-6.7 mm long, 1.1-2 mm wide, ± oblanceolate, acute to acuminate, pale to dark reddish-brown distally, whitish-hyaline proximally with a ± papillose, pale green to pale brown center, sometimes with narrow hyaline margins, 3-nerved. Lower portion of style bony and persistent,  $\pm$ straight to contorted, stigmas 3. Stamens 3, anthers 2.8-3.9 mm long. Perigynia 3.1-4.5 mm long, 1.7-2.5 mm wide, ascending, glabrous, nearly terete, broadly ovoid, faintly few-nerved or essentially nerveless, pale yellowish-brown to dark brown, coriaceous, ± tightly enclosing achene, contracted to a beak; beaks 0.4-0.8 mm long, glabrous, bidentulate with teeth 0.2-0.3 mm long. Achenes 2-2.8 mm long, 1.3-2 mm wide, trigonous with ± flat to slightly concave, elliptic to obovate sides, finely papillose, brown.

Specimens Examined (herbarium abbreviations follow Holmgren et al. 1990): ILLI-NOIS. WINNEBAGO CO.: top of high gravel bluff of Rock River, below the sanitary district in the area formerly occupied by Camp Grant, 29 Apr 1949, Fell 49-115 (ILL, ISM) [ISM specimen label reads: Gravel bluff of Rock River, N edge of Camp Grant near disposal plant]; wooded gravel bluff of Rock River at Camp Grant, S of Rockford, 23 May 1953, Fell 53-147 (ILL); 6 Jul 1953, Fell 53-679 (ILL, MICH); 16 Jun 1954, Fell 54-489 (holotype of C. fulleri: ILL; isotypes ILL, ISM, MICH); Camp Grant, shaded gravel bluff, 14 Jun 1955, Fell & Fuller 17202 (ILL, ISM, MICH); Camp Grant, S of Rockford, wooded gravel bluff of Rock River, 14 Jun 1955, Fell 55-475 (PENN); shaded gravel bluff, 30 May 1960, S. Spongberg s.n. (A, MICH); along Rock River & US bypass 20, Sec. 11, T42N, R1E, South Rockford Quadrangle, 26 Jul 1991, Jones 188 (MICH, MOR).

#### **ACKNOWLEDGMENTS**

I thank Gerould Wilhelm for providing me with good recent specimens of this plant collected by Michael D. Jones, information about its occurrence, and unpublished flowering dates for *Carex* species in the Chicago region. Michael D. Jones provided historical information, as well as information on the current status of the population. I am also grateful for the hospitality and help of the curators of all the herbaria that I visited or from which I borrowed (A/GH, ILL, ISM, MICH, MO, MOR, NY, PH/PENN, US, WIS). George Yatskievych kindly sent information on ILL sheets of *C. fulleri* on loan to MO.

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- Boivin, B. 1992. Les Cypéracées de l'est du Canada. Provancheria 25: 1-230.
- Cayouette, J., & P. M. Catling. 1992. Hybridization in the genus Carex with special reference to North America. Bot. Rev. (Lancaster) 58: 351-438.
- Fell, E. W. 1956. Notes on a new hybrid Carex. Rhodora 58: 318-320.
- Ford, B. A., P. W. Ball, & K. Ritland. 1991. Allozyme diversity and genetic relationships among North American members of the short-beaked taxa of Carex sect. Vesicariae (Cyperaceae). Syst. Bot. 16: 116-131.
- Holmgren, P. K., N. H. Holmgren, & L. C. Barnett. 1990. Index Herbariorum, part I, 8th ed., Regnum Veg. 120: x + 1-693.
- McGregor, R. L., L. K. Magrath, & R. R. Weedon. 1972. New and interesting plants from the Great Plains. Rhodora 74: 378-388.
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- Ohwi, J. 1936. Cyperaceae Japonicae. I. A synopsis of the Caricoideae of Japan, including the Kuriles, Saghalin, Korea, and Formosa. Mem. Coll. Sci. Kyoto Imp. Univ., Ser. B., Biol. 11: 229-530.

# MICHIGAN PLANTS IN PRINT,

#### New Literature Relating to Michigan Botany

Continued from this journal 31: 119 (1992). For description of this series, see 26: 174 (1987). -Edward G. Voss

#### A. MAPS, SOILS, GEOLOGY, CLIMATE, GENERAL

(U. S. Department of Agriculture, Soil Conservation Service). Soil surveys for Chippewa and Presque Isle counties have been distributed since our previous listing in May 1992. These all include complete aerial photographic coverage with boundaries of soil types overprinted. Such surveys are very useful in planning or interpreting field work. Michigan surveys are available from Soil Conservation Service, USDA, 1405 S. Harrison Rd., Room 101, East Lansing, MI 48823.

(U. S. Geological Survey). Since the previous mention of topographic maps (May 1992), only 5 new or revised topographic maps have been issued for Michigan. All are 7 1/2-minute quadrangles and cover parts of St. Clair and Macomb counties (Goodells, Memphis, Port Huron, Romeo, and Smiths Creek quads). In addition, intermediate-scale maps (1:100,000) for the following areas have been issued: Big Rapids, Croswell, Crystal Lake, Detroit, Hancock, Harbor Beach, Lake St. Clair, L'Anse, Marquette, Pointe aux Barques, Ontonagon, and Sault Ste. Marie South. A new (1991) State Index booklet is available. All maps can be ordered from USGS Map Distribution, Box 25286, Bldg. 810, Denver Federal Center, Denver, CO 80225.

#### B. BOOKS, BULLETINS, SEPARATE PUBLICATIONS

McKinney, Landon E. 1992. A Taxonomic Revision of the Acaulescent Blue Violets (Viola) of North America. Sida, Bot. Misc. 7. 60 pp. \$10.00 + \$1.00 p/h. [Includes keys, brief descriptive and ecological notes, illustrations, some unexpected nomenclature, and extensive citations of specimens; however, since the author examined specimens in no Michigan herbarium, the citations and maps grossly under-represent or misrepresent distribution here (e.g., no V. pedata or V. pedatifida in Michigan, no sororia or cucullata in the U.P., no affinis in L.P.).]

Wang, Yei-Zeng, & James W. Kimbrough. 1992. Monographic Studies of North American Species of Octospora Previously Ascribed to Lamprospora (Pezizales, Ascomycetes). Natl. Mus. Nat. Sci. (Taiwan) Spec. Publ. 4. 68 pp. [O. arvensis and O. carbonicola are cited

from Michigan localities.]

#### C. JOURNAL ARTICLES

Allen, Bruce. 1991. A review of the Fontinalis sullivantii complex (Musci: Fontinalaceae). Bryologist 94: 430-434. [The "disticha-expression" of this species is cited from Gratiot County and so mapped.]

Brieger, Gottfried, James R. Wells, & R. Douglas Hunter. 1992. Plant and animal species composition and heavy metal content in fly ash ecosystems. Water, Air, Soil Poll. 63: 87-103. [The two sites studied were in St. Clair and Monroe counties, from which vascular plants are listed and analyzed for trace elements.]

Burckhalter, Robert E. 1992. The genus Nyssa (Cornaceae) in North America: A revision. Sida 15: 323-342. [Distribution map includes 20 Michigan counties for N. sylvatica, based on

- specimens examined. Ten additional counties (including a new northern limit (Manistee)) were mapped in *Michigan Flora*.]
- Cameron, Randall G. 1990. Spatial patterns and sex ratios in dioecious and monoecious mosses of the genus Splachnum. Bryologist 93: 161-166. [Study of 3 species on Isle Royale.]
- Catling, Paul M. 1984. A re-evaluation of Spiranthes ×steigeri Correll. Rhodora 86: 469–473. [This name reduced to synonymy of *S. ochroleuca*; previous Chippewa and Barry county reports discussed.]
- Cid-Benevento, Carmen R. 1987. Relative effects of light, soil moisture availability and vegetative size on sex ratio of two monoecious woodland annual herbs: Acalypha rhomboidea (Euphorbiaceae) and Pilea pumila (Urticaceae). Bull. Torrey Bot. Club 114: 293–306. [Seed from "southwestern Michigan" used for greenhouse studies at six light levels and three soil mixtures.]
- Eckert, Christopher, & Spencer C. H. Barrett. 1992. Stochastic loss of style morphs from populations of tristylous Lythrum salicaria and Decodon verticillatus (Lythraceae). Evolution 46: 1014–1029. [Michigan is one of the 4 "regions" from which *Decodon* was studied, and map shows occurrence of the 3 morphs in L.P.]
- Goldberg, Deborah A. 1987. Seedling colonization of experimental gaps in two old-field communities. Bull. Torrey Bot. Club 114: 139-148. [Study in two midsuccessional old fields at the Kellogg Biological Station (Kalamazoo Co.).]
- Hellquist, C. Barre. 1984. Observations of Potamogeton hillii Morong in North America. Rhodora 86: 101-111. [Thorough citing and mapping include extensive Michigan occurrence of this rather localized species, with recommendation that it not be considered for protection.]
- Ireland, Robert R., & Michael J. Shchepanek. 1993. The spread of the moss Hyophila involuta in Ontario. Bryologist 96: 132-137. [Text and map indicate Michigan localities in Ontonagon, Alger, and Chippewa counties for this presumably boat-dispersed species from the south.]
- Jensen, Richard J. 1986. Geographic spatial autocorrelation in Quercus ellipsoidalis. Bull. Torrey Bot. Club 113: 431-439. [Four Michigan sites (north to Oscoda Co.) included in study showing clinal variation in size characters and little correlation in shape characters of fruit.]
- Kim, Ki-Joong, & Billie L. Turner. 1992. Systematic overview of Krigia (Asteraceae-Lactuceae). Brittonia 44: 173-198. [Distribution map for K. biflora var. biflora shades all of Michigan (except Isle Royale), even though the base map has county borders; consequently the very spotty distribution of this species is obscured; there is no map for K. virginica and no Michigan specimens are cited for either species.]
- Lamboy, Warren F., Daniel L. Nickrent, & Almut G. Jones. 1991. Isozyme evidence and phenetic relationships among species in Aster section Biotia (Asteraceae). Rhodora 93: 205-225. [A. macrophyllus collections from Benzie and Grand Traverse counties are cited.]
- Loconte, Henry, & Will H. Blackwell. 1985. Intrageneric taxonomy of Caulophyllum (Berberidaceae). Rhodora 87: 463-467. [Woefully incomplete distribution map shows some Michigan locations for both *C. thalictroides* and *C. giganteum*.]
- Mears, James A. 1975. The taxononmy of Parthenium section Partheniastrum DC. (Asteraceae-Ambrosiinae). Phytologia 31: 463-482. [Cites Kalamazoo County railroad collections of *P. integrifolium* var. *hispidum* and notes their disjunction from native range.]
- Montagnes, R. Joan S. 1990. The habitat and distribution of Meesia triquetra in North America and Greenland. Bryologist 93: 349-352. [Distribution map includes 5 dots in Michigan.]
- Overlease, William R. 1991. Genetic relationships between three species of oaks as determined by common garden studies with populations from Michigan, Indiana, and Wisconsin. J. Pennsylvania Acad. 65: 71-74. [Most of the populations of red, black, and scarlet oak that provided seeds were from Michigan sites.]
- Pryer, Kathleen M., & Christopher H. Haufler. 1993. Isozymic and chromosomal evidence for the allotetraploid origin of Gymnocarpium dryopteris (Dryopteridaceae). Syst. Bot. 18: 150-172. [One of the sites for material analyzed was in Marquette Co., and distribution

- map includes many Michigan dots; 5 Michigan localities are included on a map for plants with malformed spores (which may be G. ×brittonianum).]
- Reznicek, A. A., & P. M. Catling. 1987. Carex praegracilis (Cyperaceae) in eastern North America: A remarkable case of rapid invasion. Rhodora 89: 205-216. [Maps show known Michigan distribution up to 1970 and up to 1984; doubts that old U.P. records are indigenous.]
- Rothrock, Paul E. 1991. The identity of Carex albolutescens, C. festucacea, and C. longii (Cyperaceae). Rhodora 93: 51-66. [Distribution maps include dots in Michigan for all 3 species and one Kalamazoo Co. collection of *C. longii* is cited.]
- Russell, Emily W. B. 1987. Pre-blight distribution of Castanea dentata (Marsh.) Borkh. Bull. Torrey Bot. Club 114: 183–190. [With apparently no new investigation into herbarium labels or literature, disposes of chestnut in Michigan only with "Outlier populations, for example in Michigan, Illinois and Iowa, were probably naturalized from planting attempts" and cites only an 1878 reference!]
- Semple, John C., & Jerry G. Chmielewski. 1985. The cytogeography of Aster pilosus (Compositae-Astereae) II. Survey of the range, with notes on A. depauperatus, A. parviceps and A. porteri. Rhodora 87: 367–379. [Map indicates A. pilosus var. pringlei and var. pilosus in Michigan, with the former cited from 3 places in Mackinac Co. and the latter from Branch, Clare, Hillsdale, Lenawee, Oakland, and Washtenaw counties. A glance at a map would, however, show that "Hillsdale Co.: S of Ann Arbor" is a geographic impossibility. The abundant citing of highway numbers and intersections is a deplorable way of labeling specimens, for these designations are ephemeral as routes change location or are deleted.]
- Semple, John C. 1985. Chromosome number determinations in fam. Compositae tribe Astereae. Rhodora 87: 517-527. [Includes counts of 2n = 48 for *Aster ciliolatus*, 2n = 16 for *A. lateriflorus*, and 2n = 18 for *Solidago uliginosa* from Delta Co.]
- Semple, John C., Jerry G. Chmielewski, & Meredith A. Lane. 1989. Chromosome number determinations in fam. Compositae, tribe Astereae. III. Additional counts and comments on generic limits and ancestral base numbers. Rhodora 91: 296-314. [Includes count of 2n = 48 for Aster laevis var. laevis from Crawford, Delta, Mackinac, and Roscommon counties, although some highway designations are obsolete or erroneous.]
- Semple, John C., Jerry G. Chmielewski, & Chunsheng Xiang. 1992. Chromosome number determinations in fam. Compositae, tribe Astereae. IV. Additional reports and comments on the cytogeography and status of some species of Aster and Solidago. Rhodora 94: 48-62. [Count of 2n = 16 given for *A. puniceus* from Mackinac Co.]
- Shaw, A. Jonathan, N. J. Niguidula, & T. M. Wilson. 1992. Reproductive biology of the rare "copper moss" Mielichhoferia mielichhoferiana. Contr. Univ. Michigan Herb. 18: 131-140. [Only Michigan population is said to be in Pictured Rocks National Lakeshore, and spore germination percentages were determined from it.]
- Sheviak, Charles J., & Marlin L. Bowles. 1986. The prairie fringed orchids: A pollinatorisolated species pair. Rhodora 88: 267-290. [Map includes Michigan locations for *Platanthera leucophaea*, in which pollinaria attach to the proboscis of the pollinating sphinx moth; in the newly described western *P. praeclara*, pollinaria attach to the eyes of the moth.]
- Sinnott, Quinn P. 1985. A revision of Ribes L. subg. Grossularia (Mill.) Pers. sect. Grossularia (Mill.) Nutt. (Grossulariaceae) in North America. Rhodora 87: 189-286. [Maps indicate Michigan counties for *R. cynosbati* and *R. hirtellum* and the generalized range for *R. oxyacanthoides* barely to the northernmost L.P.; selected Michigan specimens are cited for all 3 species.]
- Thomson, John W. 1991. The lichen genus Staurothele in North America. Bryologist 94: 351-367. [Four of the 17 species are cited and mapped from Michigan localities (Keweenaw Co. included for all), and the maps (S. areolata, S. clopimoides, S. fissa, and S. drummondii) show additional localities.]
- Tucker, Gordon C., & Norton G. Miller. 1990. Achene microstructure in Eriophorum (Cyperaceae): Taxonomic implications and paleobotanical applications. Bull. Torrey Bot. Club 117: 266-283. [One of the collections of *E. alpinum* cited and figured (SEM) is from Alger Co.; authors opine that this species is better classified as *Scirpus hudsonianus*.]

- Wagner, Florence S. 1993. Chromosomes of North American Grapeferns and Moonworts (Ophioglossaceae: Botrychium). Contr. Univ. Michigan Herb. 19: 83-92. [Table includes counts on Michigan collections (cited) for 16 taxa including hybrids (summarized from previous publications).]
- Weatherbee, Pamela B., & Garrett E. Crow. 1990. Phytogeography of Berkshire County, Massachusetts. Rhodora 92: 232-256. [Distribution maps for 5 species showing different geographic elements include Michigan, but they are taken from older publications and the one for *Quercus macrocarpa*, especially, is very incomplete and hence misleading.]
- Wolf, Steven J., & Keith E. Denford. 1984. Taxonomy of Arnica (Compositae) subgenus Austromontana. Rhodora 86: 239-309. [A. cordifolia cited from localities in Keweenaw Co., including type of A. whitneyi; its occurrence here is described as "only a few populations" (p. 270) and "one large discontinuous population" (p. 271).]
- Wong, Pak Yau, & Irwin M. Brodo. 1990. Significant records from the lichen flora of southern Ontario, Canada. Bryologist 93: 357–367. [The Michigan occurrence of several of the species is noted.]
- Wyatt, Robert, David M. Lane, & Ann Stoneburner. 1991. Chemosystematics of the Mniaceae. II: Flavonoids of Plagiomnium section Rosulata. Bryologist 94: 443-448. [P. ellipticum cited from Washtenaw Co.]
- Wyatt, Robert, David M. Lane, & Ann Stoneburner. 1991. Chemosystematics of the Mniaceae. III. Sources of intraspecific variation in flavonoids. Bryologist 94: 452–456. [*Plagiomnium capillare* cited from Cheboygan and Mackinac counties.]
- Wyatt, Robert, Ireneusz J. Odrzykoskim, & Ann Stoneburner. 1992. Isozyme evidence of reticulate evolution in mosses: Plagiomnium medium is an allopolyploid of P. ellipticum × P. insigne. Syst. Bot. 17: 532-550. [Some of the material studied of P. medium and P. ellipticum came from the northern L. P. although the localities listed appear somewhat confused, e.g. declaring Hammond Bay to be in Cheboygan Co. (it is entirely in Presque Isle Co.).]

#### D. HISTORY, BIOGRAPHY, EXPLORATION

- Anderson, Lewis E. 1992. A tribute to Howard Crum. Contr. Univ. Michigan Herb. 18: 3-38. [A light and thorough, copiously illustrated, biographical account to introduce a volume dedicated to the well known Michigan bryologist on his 70th birthday. Includes a complete bibliography compiled by Anderson & William R. Buck.]
- Reese, William D. 1988. Ruth Schornherst Breen (1905–1987). Taxon 37: 989. [Brief sketch of Michigan-born bryologist who spent her professional life in Florida.]
- Williams, David E., & Susan M. Fraser. 1992. Henry Hurd Rusby: The father of economic botany at the New York Botanical Garden. Brittonia 44: 273-279. [Most of Rusby's professional life was associated with the New York Botanical Garden, but he was earlier (1880s) employed as an explorer by Parke, Davis & Co. and collected some in Michigan (not mentioned in this account) but mostly in other parts of the world.]
- Wynne, Michael J. 1993. Dedication. Contr. Univ. Michigan Herb. 19: 1-3. [Biographical sketch of William Randolph Taylor, distinguished University of Michigan algologist, who died in 1990 and to whom this volume is dedicated.]

# **V** REVIEW

GOLDENRODS OF ONTARIO. *Solidago* L. and *Euthamia* Nutt. Revised edition by John C. Semple. University of Waterloo Biology Series No. 36. 82 pp. Available from (and checks made payable to) University of Waterloo Biology Series, Department of Biology, University of Waterloo, Waterloo, Ontario, Canada N2L 3G1. CAN\$13.00 postpaid. Checks in US\$ accepted.

The earlier edition of this fine work (Semple & Ringius, Univ. Waterloo Biol. Ser. No. 26. 1983) has served its purpose well. The revised edition will be welcomed by all who struggle with these DYCs (darned yellow composites) in the Great Lakes area. Those familiar with the earlier edition (text created with a dot-matrix printer, the lines fully justified though with a fixed font) will welcome the use of a laser printer with a proportional font in the present edition. The excellent and fully diagnostic full-page plates (from Semple's skilled hand) are unchanged, except for Solidago simplex, which was completely re-studied. Distribution maps are included in each plate. In the introduction, the author warns against flipping through and looking at the pictures for purposes of identification, but one suspects the temptation to do so will be strong.

The keys are very clear and detailed. Descriptions of species are unusually full, including measurements of both achenes and pappus for both ray and disc florets. Chromosome numbers are given throughout; Semple indicates which numbers are known for Ontario plants (boldface) and which are known from elsewhere in the range of the taxon (normal type). I find such careful scholarship and concern for accuracy admirable. Equally admirable is the gentle, conversational tone of the entire work — an experienced professor patiently explaining, to beginners and experts alike.

Semple carefully presents the various arguments for recognition of a taxon at specific or other rank. The reader will note numerous differences from the continent-wide treatment of Scoggan, *Flora of Canada*. The citations of synonymy are helpful; while it is not quite true that every goldenrod has four or more valid names, it's *nearly* true.

The work concludes with an ample glossary and a detailed index. There are no nomenclatural innovations, so far as I could detect.

— Neil A. Harriman Biology Department University of Wisconsin-Oshkosh Oshkosh, WI 54901

# THE BIG TREES OF MICHIGAN. 2. Populus tremuloides Michaux.

Elwood B. Ehrle

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Michigan's largest known quaking aspen is located in Porcupine Mountain State Park in Ontonagon County of Michigan's Upper Peninsula. It is both a State and National Champion tree but may become downgraded by the American Forestry Association due to reduction in crown size resulting from the recent loss of several large limbs.

Description of the species: Poplars are members of the willow family, Salicaceae. They are distinguished from the willows (Salix spp.) by their ovate to deltoid leaf blades, the several overlapping bud scales (willow buds are covered by a single scale), the coarse toothed, lacerate, or fringed bracts in the inflorescence (bracts in willow catkins are smooth-edged), the cuplike disk at the base of each male flower (willows have no disk), and a flower stigma of four or more lobes (willow flowers have two stigmas which are unlobed). Voss (1985) listed seven species of Populus in his Michigan Flora. The quaking aspen is distinguished from other poplars which grow in the state by its strongly flattened leaf petioles, leaf blades which are hairless or nearly so at maturity and ovate to nearly orbicular in shape, and its finely serrate leaf margins (Fig. 1). The flattened nature of the petiole, especially near the blade, causes the leaf blade to tremble in the slightest breeze, hence its specific epithet and common name.

Location of Michigan's Big Tree: Porcupine Mountain State Park is located in the northwest corner of Ontonagon County. The Park is bordered on the southeast by the South Boundary Road. The tree is located along the south side of South Boundary Road and is northwest of Nonesuch Falls (Section 1 of T50N, R43W). It is 26' (7.9 m) from the road near the end of the large S-shaped curve in the road. As you come around the first bend of the S, the tree is 750' (229 m) straight ahead near the end of the straight section before the opposite curve of the S begins. It is in a mixed deciduous-coniferous woods of fir, spruce, maple, elm, and balsam poplar. The tree bears an embossed aluminum Michigan Botanical Club sign.

Description of Michigan's Big Tree: The tree trunk is quite sound and essentially healthy although it is apparently no longer growing. The circumference of the trunk was measured on August 18, 1991 at 122" (310 cm) [39" (99 cm) diameter], the same circumference reported by Thompson (1986). It has, however, lost 25% of its crown spread since it was measured for the 1986 paper. The earlier crown spread of 80' (24.4 m) reported by Thompson (1986) was measured in 1991 at only 59' (18 m). The crown is vulnerable since at 109' (33.2 m) in height it is considerably taller than the crowns of

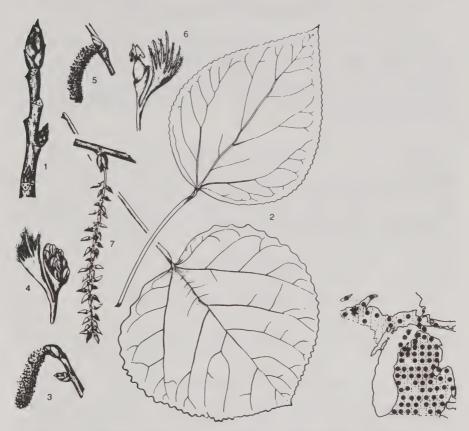


FIGURE 1. Documented distribution in Michigan and characteristics of the quaking aspen. The map is from Voss (1985), the star indicates the location of Michigan's Big Tree. Drawings are from Barnes & Wagner (1981). 1. Winter twig, × 2; 2. Leaves, × 1; 3. Male flowering catkin, × 1/2; 4. Male flower, enlarged; 5. Female flowering catkin, × 1/2; 6. Female flower, enlarged; 7. Fruiting catkin with capsules, × 1/2.

nearby trees. Two fallen branches lying on the ground next to the trunk have girths of 32" (81.3 cm) and 34" (86.4 cm). Since State Champion designation is based on girth only (Thompson 1986), this tree is likely to continue to be State Champion as long as it lives unless a larger one is found in the state. National Champions, however, are based on calculations of the American Forestry Association by adding girth in inches to the height in feet, plus one-fourth of the crown spread in feet. The significant loss in crown spread between 1986 and 1991 may cause the Michigan Champion to lose its National Champion status.

#### INVITATION TO PARTICIPATE

If you would like to join us in extending this series of articles by visiting and describing one or more of Michigan's Big Trees, please contact one of us for help with locations, specifications for taking measurements, and assistance with the manuscript. The Michigan Botanical Club encourages your involvement in this activity. Please remember to ask permission before entering private property.

#### LITERATURE CITED

Barnes, B. V., & W. H. Wagner, Jr. 1981. Michigan Trees. A Guide to the Trees of Michigan and The Great Lakes Region. Univ. Michigan Press, Ann Arbor. xiii + 383 pp.
Thompson, P. W. 1986. Champion trees of Michigan. Michigan Bot. 25: 112-118.
Voss, E. G. 1985. Michigan Flora. Part II. Dicots (Saururaceae-Cornaceae). Bull. Cranbrook Inst. Sci. 59 and Univ. Michigan Herbarium. xix + 724 pp.



### EDITORIAL NOTICES

#### **NEW BUSINESS MANAGER APPOINTED**

We are pleased to announce that the position of Business and Circulation Manager has been filled via the appointment of Judy Kelly. Judy has been a member of the Huron Valley Chapter for a number of years and is a Biology Instructor at Henry Ford Community College.

#### NEW ADDRESS CHANGE PROCEDURE

With a change in US Postal Service regulations looming in the near future, the process of maintaining the address lists for *The Michigan Botanist* are changing. Our past practice was to request a set of address labels from each chapter every time an issue of *The Botanist* was ready for mailing; only the address list of subscribers was maintained by the Business and Circulation Manager. The entire list, members and subscribers alike, is now being merged and will be the basis for all future mailings of *The Botanist*. We now request that ALL address changes be submitted directly to the Business and Circulation Manager. This is particularly important since undeliverable copies of *The Botanist* are NOT returned—if you don't tell us of an address change, we may not find out about the change via a returned issue.

- Richard K. Rabeler & Gary L. Hannan

## NOTEWORTHY COLLECTIONS \*

## MICHIGAN, NEW YORK, AND WISCONSIN

DIANTHUS CARTHUSIANORUM L. (Caryophyllaceae). Cluster-head Pink.

Previous knowledge. This species has been reported from only one site in Michigan (see Rabeler & Gereau 1984, Voss 1985; Houghton Co., Rabeler 659 (BH, GH, MICH, MSC, NY, US) & 710 (BH, DAO, GH, MICH, MIN, MSC, NA, NY, US). I am not aware of any other reports from the Great Lakes region.

Significance. These collections document the occurrence of *D. carthusianorum* in the Lower Peninsula of Michigan, northern Wisconsin, and most recently, northern New York. The Wisconsin collection may represent an unintentional escape from cultivation; during an attempt to replicate that collection in 1990, the collector noted that several fields of cultivated plants that may have included *D. carthusianorum* were near the site (D. J. Sieren, pers. comm.).

MICHIGAN. MANISTEE CO.: small dump and refuse area, NE corner of Co. Rd. 669 & Neesen City Rd., N side of Copemish, SE 1/4 of Sec. 7, T24N, R13W, 13 Jun 1991, Garlitz 3433 (M1CH).

WISCONSIN. BAYFIELD CO.: roadside ditch along County Trunk T, NW of Bayfield, 19 Jun 1978, *Sieren 1607* (MICH (photocopy), MASS, NLU, WIS (photocopy), [WNC]).

**NEW YORK.** ESSEX CO.: dry, sandy field, S side of NY 86, 3.7 km W of Jay, Town of Wilmington, 3 Jul 1993, *Reznicek 9588 & Reznicek* (MICH, NYS).

#### LITERATURE CITED

Rabeler, R. K., & R. E. Gereau. 1984. Eurasian introductions to the Michigan Flora. I. Michigan Bot. 23: 39-47.

Voss, E. G. 1985. Michigan Flora. Part II. Dicots (Saururaceae-Cornaceae). Bull. Cranbrook Inst. Sci. 59 and Univ. Michigan Herbarium. xix + 724 pp.

— RICHARD K. RABELER University of Michigan Herbarium North University Building Ann Arbor, MI 48109-1057

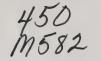
#### **ERRATUM**

Figures 2 and 3 (range maps for *Populus heterophylla* and *Fraxinus tomentosa* respectively) on page 37 of Vol. 32 (no. 1) were accidentally reversed.

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On the cover: Tamarack (Larix laricina)
Photographed by E.B. Mains



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# MICHIGAN BOTANIST

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Articles dealing with any phase of botany relating to the Great Lakes Region may be sent to the Coeditors. In preparing manuscripts, authors are requested to follow our style and the suggestions in "Information for Authors" (Vol. 28, p.43; Vol. 29, p.143).

#### Editorial Board

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Membership in the Michigan Botanical Club is open to anyone interested in its aims: conservation of all native plants; education of the public to appreciate and preserve plant life; sponsorship of research and publication on the plant life of the State; sponsorship of legislation to promote the preservation of Michigan native flora; establishment suitable sanctuaries and natural areas; and cooperation in programs concerned with the wise use and conservation of all natural resources and scenic features.

Dues are modest, but vary slightly among the chapters and with different classes of membership. Persons desiring to become state members (not affiliated with a local chapter, for which contact persons are listed below), may send \$17.00 dues to the Membership Chairperson listed below. In all cases, dues include a subscription to *THE MICHIGAN BOTANIST*. (Persons and institutions desiring to subscribe without becoming members should deal directly with the Business and Circulation Manager.)

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# THE VASCULAR FLORA OF NORTH AND SOUTH FOX ISLANDS, NORTHERN LAKE MICHIGAN

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#### INTRODUCTION

North and South Fox islands (Fig. 1) lie in the middle of a chain of islands which includes the Manitou Islands to the southwest and the Beaver Islands to the northeast. The Fox Islands, glacial landforms which have been reworked by wind and water since their initial deposition, are part of Leelanau County, but are mapped in Michigan Flora (Voss 1972, 1985) as a unit apart from the county's mainland portion.

The geology of this region, with an emphasis on North Fox, has been described by Wells et al. (1975). Throughout the history of the islands, the water level in the Lake Michigan basin has fluctuated considerably. During the highest and earliest of these levels (Algonquin phase) about 11,000 years ago, parts of South Fox remained above the lake while North Fox was completely inundated. After the Algonquin phase, water levels dropped radically to the Chippewa phase. In some places levels fell to about 350 ft (107 m) below the present level of Lake Michigan. Although both islands were larger at this time, they were never connected to each other or to the mainland. Following the Chippewa phase, water levels rose above the present level of Lake Michigan (Nipissing phase), but during this phase neither island was completely submerged. Lake Michigan levels subsided to those of the present after the Nipissing phase.

Descriptions of the islands' vegetation began with a casual note by Fuller (1918) on the dune vegetation of South Fox. Later a short vegetation description of both islands was included by Hatt et al. (1948). Wells et al. (1975) later described the vegetation of North Fox based on trips made in August 1973 and in June 1974.

The earliest known plant collections from the Fox islands were made in 1961 by three biologists from the University of Michigan Biological Station. Frederick H. Test's zoological research on Lake Michigan islands first brought him to South Fox in 1961. In June he was accompanied by Elzada U. Clover, a botanist. In August of the same year, Test returned to the island with his nephew, Larry Wolf, an undergraduate who was studying at

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FIGURE 1. North and South Fox islands with inset showing their location in Lake Michigan.

the Station that summer. Test collected additional specimens on South Fox in July 1962. In July 1963, he made the first collections from North Fox.

No additional Fox Island collections are known to have been made until the 1984 island expedition aboard the *Noble Odyssey* described by Hazlett et al. (1986). Subsequent to the *Noble Odyssey* trip, I visited the Fox Islands

six times as part of my dissertation fieldwork (Hazlett 1988); three visits in 1985 [NF: 5/21-5/22, 6/27-6/28, 8/14-8/15; SF: 5/22-5/24, 6/28-6/30, 8/15-8/16], two in 1986 [NF: 6/10-6/12, 8/12-8/13; SF: 6/12-6/14, 8/13-8/14], and one in 1987 [NF: 6/2-6/3; SF: 6/3-6/4]. This paper summarizes the floristic work as of 1988.

#### SOUTH FOX ISLAND

This island (Fig. 2) covers 3,264 acres (5.1 mi²; 1321 ha; 13.2 km²) and lies 17 miles (27.4 km) north-northeast of North Manitou and 17 miles northwest of Cathead Point, the nearest mainland. The central core of the island is moraine with soils (Weber 1973) that are predominantly sands (Deer Park and Eastport series) and loamy sands (Kalkaska, Leelanau, and Mancelona series). The west side of the moraine has been eroded by Lake Michigan to form bluffs which rise up to 200 feet (61 m) above the lake. Exposed sand from these bluffs has been driven up by the prevailing westerly winds and deposited as perched dunes atop the moraine. In some areas, such as at the north end of the island, dunes have stopped growing and northern hardwoods have developed on them. Coastal dunes, those that have developed at present lake level, occur near the south end of the island and along the east shore, especially in a large area of scattered low dunes and dune pools in Sec. 33.

Nicholas Pickard founded a cordwood supply operation on South Fox in 1850 (Craker 1983). In addition to periodic logging, the island was settled by a few farmers and was a base for fishing operations. The airstrip (Sec. 10) and surrounding old fields are presently the largest cleared region on the island. Smaller fields are scattered across the island and most of these having few shrubs or saplings are at a very early stage of secondary succession.

The Michigan Department of Natural Resources (1975) has mapped the vegetation of South Fox as being composed of northern hardwoods, cedarbalsam, sand and dune, and clearings. The vast majority of the island's vegetation is northern hardwoods with an overstory of *Acer saccharum*, *Fraxinus americana*, and *Fagus grandifolia*. A small outlier of northern hardwoods, separated from the rest of the forest by dunes, occurs at the island's south end near the lighthouse.

Within the northern hardwoods, a few local areas have abundant soil moisture throughout the growing season. Such areas are collectively referred to as moist northern hardwoods in this paper. The largest of these areas is a swale in the woods along the west side of the airstrip. Another of these areas is the region near a large field in Sec. 32. Within this field is a small waterhole in and around which are found *Liparis loeselii*, *Habenaria hyperborea*, and *Potamogeton foliosus*. The woods immediately to the west of this field (and west of a smaller field to the north) are soggier than the adjacent woods.

The cedar-balsam areas lie between the northern hardwoods and the

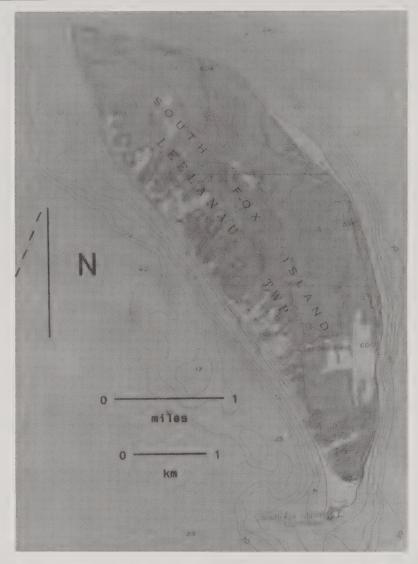


FIGURE 2. Topographic map of South Fox Island from USGS South Fox Island Quadrangle, 15 Minute Series, 1956. Contour interval 20 feet.

dunes. The overstory of these areas consists mainly of *Thuja occidentalis*, *Betula papyrifera*, and *Abies balsamea*. Among the most botanically interesting areas on the island are the interdunal valleys of the perched dunes where the northern hardwoods and cedar-balsam areas meet. Species largely restricted to such areas include *Asplenium viride*, *Polystichum lonchitis*, *P. braunii*, and *Panax quinquefolius*.

### NORTH FOX ISLAND

This island (Fig. 3) is the smaller (837 acres; 1.3 mi²; 339 ha; 3.4 km²) of the two and lies 4.5 miles (7.2 km) northeast of South Fox. Beaver Island, 11 miles (17.7 km) to the northwest, is closer than Cathead Point, the nearest mainland (20.5 mi; 33.1 km). The island's soils (Weber 1973) are predominantly sandy loams (Alpena, Detour, and Emmet series) with some sands (Deer Park and Eastport series) and loamy sands (Kalkaska, Leelanau, and Mancelona series). The beaches are sandy on the west side and largely cobble on the east and north sides of the island.

The island, dominated by a central plateau, shows little topographic relief. On the north side, the plateau is bordered by a band of relict beach ridges between the base of the Nipissing bluff and Lake Michigan. Dunes are limited to a small blowout crossing the island's southwest corner. Portions of the island's interior are very swampy, perhaps due to a clay layer which formed during the Algonquin phase of Lake Michigan. Water collects in a large pool in the woods of the island's southern central portion.

Little is known about the settlement of North Fox. General Land Office Survey notes from 1847 show that fishermen were among the first settlers. The island's swampy nature probably prevented extensive farming. Hatt et al. (1948) observed that most of the good timber had been cut, but no clearings remained; therefore, logging on the island has probably not occurred for at least 75 years. The only cleared area on the island, an airstrip built during 1961 and 1962, cuts from east to west across the northern portion of the plateau. Its very moist edges provide ideal habitat for rushes and sedges. Gravelly borrow pits lie at the east end of the airstrip and along a trail to its south.

Wells et al. (1975) described six vegetation associations for North Fox: hardwood forest (dominated by Acer saccharum and Fagus grandifolia); lowland conifer forest (dominated by Abies balsamea, Thuja occidentalis, and Betula papyrifera); swamp forest (dominated by Ulmus americana, Acer rubrum, and Fraxinus nigra); mixed forest (dominated by Acer rubrum, A. saccharum, Betula papyrifera, Abies balsamea, and Thuja occidentalis); dunes and sandy beaches; and meadow and grassland plants. The lowland conifer forest principally occupied the post-Nipissing beach ridges at the north end of the island. The hardwood forests and swamp forests shared the central plateau. The mixed forest was a transition area between the plateau forests and beaches on the island's west side. The majority of the meadow and grassland plants were associated with the airstrip.

My interpretation of the vegetation patterns on North Fox is essentially the same, although I have not included a "mixed forest". In this paper, my terms "northern hardwoods" and "wet northern hardwoods" are respectively, roughly analogous to the hardwood forest and swamp forest of Wells et al. (1975). I would, however, include *Fraxinus americana* as a dominant species of the northern hardwoods, and *Populus balsamifera* as a dominant species of the lowland conifer forest. (A recent vegetation map of North Fox (Reese, 1989) shows "boreal forest" for lowland conifer forest regions

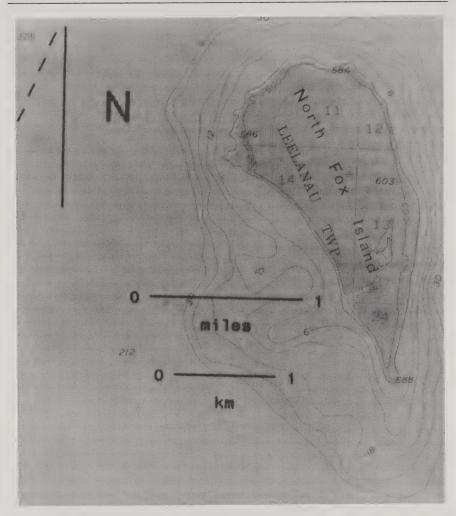


FIGURE 3. Topographic map of North Fox Island from USGS South Fox Island Quadrangle, 15 Minute Series, 1956. Contour interval 20 feet.

described by Wells et al. (1975), "mesic northern forest" for the hardwood forest, and "northern swamp" for swamp forest.)

#### FLORISTIC DIFFERENCES

When hybrids, ornamentals, cultivated plants, and recently escaped species are excluded, the total flora of native and alien species on South Fox is larger (367) than that of North Fox (342). For native species alone, however,

the North Fox has slightly more (300) than South Fox (292). The combined flora of both islands is 453 species, of which 250 species are shared. Differences between the island floras can be attributed largely to habitat differences. Few wet sites occur on South Fox. Thus native wetland species apparently absent from South Fox such as Agalinis purpurea, Equisetum fluviatile, Eupatorium maculatum, Habenaria clavellata, Iris virginica, Listera convallarioides, Lobelia kalmii, Lysimachia thyrsiflora, Malaxis monophylla, Osmunda cinnamomea, O. regalis, Phalaris arundinacea, Salix bebbiana, Scirpus pendulus, S. validus, Scutellaria galericulata, S. lateriflora, Sium suave, Solidago graminifolia, and Spiranthes romanzoffiana were easily found along the North Fox airstrip, or in the wet northern hardwood forests of the island's interior. South Fox does not have a lowland conifer forest comparable to that found on the post-Nipissing beach ridges of North Fox. Species from this area found only on North Fox include Calypso bulbosa, Coptis trifolia, Corallorhiza trifida, Cornus canadensis, Goodyera tesselata, Thalictrum dasycarpum, Thelypteris palustris, and Trientalis borealis. South Fox, on the other hand, has a more extensive sand dune system than North Fox, in part because the island intercepts most of the prevailing southwesterly winds. Native sand dune species found only on South Fox include Andropogon scoparius, Anemone multifida, Asclepias viridiflora, Botrychium campestre, Euphorbia polygonifolia, Hudsonia tomentosa, Koeleria macrantha, and Orobanche fasciculata.

Alien species on South Fox comprise about 20% of the flora, but on North Fox only about 11%. The only open area on North Fox is the airstrip, which is continually moved throughout the growing season. Thus some alien perennials which have reached recognizable maturity in the old fields on South Fox such as Ambrosia psilostachya, Chrysanthemum leucanthemum, Leonurus cardiaca, Medicago sativa, Melilotus alba, Panicum miliaceum, Potentilla recta, Saponaria officinalis, Trifolium hybridum, and Vicia villosa have not done so, or have not become established, on North Fox. Annuals and biennials, whose persistence is favored by disturbance, are more common on South Fox. The island historically has been subject to the disturbance associated with lumbering, most recently during 1985 and 1986. Alien annuals and biennials found only on South Fox include Artemisia biennis, Barbarea vulgaris, Berteroa incana, Camelina microcarpa, Cynoglossum officinale, Lepidium campestre, L. densiflorum, Malva neglecta, Pastinaca sativa, Portulaca oleracea, Silene noctiflora, Sisymbrium altissimum, S. officinale, Solanum nigrum, and Trifolium dubium.

### CATALOGUE OF VASCULAR PLANTS

The following list of 79 families, 247 genera, 469 species, and 4 hybrids represents the known floristic work as of 1988 on the Fox Islands. Unless specifically noted, all species listed and numbered represent my collections, most of which (86%) have been deposited at the University of Michigan

Herbarium (MICH). The other 14% (unicates of taxa supported by other numbers at MICH) have been deposited in herbaria (listed in decreasing number of specimens) at Lakehead University (LKHD), University of Waterloo (WAT), Université Laval (QFA), University of Michigan Biological Station (UMBS), and Michigan State University (MSC). Numbers prefaced with FI are those collections from the 1984 Fox Island expedition and are deposited in the herbarium of Cranbrook Institute of Science (BLH). With the exception of *Rubus parviflorus* (MICH and UMBS) and *Panax quinquefolius* (MICH), all Fox Island collections made by Test, Clover, and Wolf are deposited at UMBS. North and South Fox have been abbreviated as NF and SF, respectively. Generally, nomenclature and common names follow Lellinger (1985) for ferns and fern allies, and Gleason and Cronquist (1963) for those groups not covered by Voss (1972, 1985). Synonomy for orchids follows Case (1988). Another source of common names is Peterson & McKenny (1968).

The families within the pteridophytes, gymnosperms, monocots, and dicots, and then the species within each family, are listed in alphabetical order. The largest family, the Compositae, is represented by 44 species. Carex, the largest genus, has 32 species. Michigan threatened species within the Fox Island flora include Botrychium campestre (dunewort), Bromus pumpellianus (Pumpelly's brome grass), Cirsium pitcheri (Pitcher's thistle), Calypso bulbosa (calypso), Orobanche fasciculata (broom-rape), Panax quinquefolius (ginseng), and Tanacetum huronense (Lake Huron tansy). Cirsium pitcheri is also federally listed as threatened. Asplenium viride (green spleenwort) is a Michigan special concern species (Michigan Department of Natural Resources 1989).

Abundance estimates based on field observations and collections follow the scale described in Voss (1972, p. 24). Abbreviations for these estimates are: C, common; F, frequent; O, occasional; L, local; R, rare. Abundance estimate have not been designated for species known only from specimens collected only by Test, Clover, or Wolf. Locality and habitat data also have not been included for these species; label data for Test and Wolf specimens typically have only date of collection and the island from which the collection was made. Clover's specimens usually have some habitat data included on the labels, but "woods west of airstrip" on labels for dune species such as Zigadenus glaucus, Lithospermum caroliniense, Artemisia caudata, Coreopsis lanceolata, Oenothera oakesiana, and Rosa blanda casts doubt on the accuracy of the label data on Clover's other specimens.

Wells et al. (1975) cited some species in their vegetation association descriptions which are not supported by vouchers. Therefore, although it is possible that these species occur on North Fox, Corallorhiza maculata, Gnaphalium macounii E. Greene, Lycopodium clavatum L., Potentilla fruticosa L., Rorippa palustris, Satureja vulgaris, Solidago nemoralis, and Viola pallens (DC.) Brainerd are not listed for that island.

#### **CHECKLIST OF VASCULAR PLANTS**

(NF: North Fox; SF: South Fox) (Common, Frequent, Occasional, Local, Rare)

#### **PTERIDOPHYTES**

#### **EQUISETACEAE** (Horsetail Family)

- Equisetum arvense L., Field Horsetail. SF: (F) Moist northern hardwoods. 3782; F1-152; Clover. NF: (C) Wet northern hardwoods and airstrip. 3061, 3303, 3312; F1-347.
- E. × ferrissii Clute, SF: (L) Dunes on east side, Sec. 33. 3355, 4016, 4636.
- E. fluviatile L., Water Horsetail. NF: (L) Airstrip. 3309, 3728, 4000, 4005; FI-403.
- E. hyemale L., Scouring-rush. SF: (C) Dunes and shores. 3358, 3366; FI-54. NF: (F) Airstrip, nearby borrow pits, and dunes. 3310, 4611, 4618; FI-388; Test.
- E. scirpoides Michaux, Dwarf Scouring-rush. SF: Clover.
- E. sylvaticum L., Woodland Horsetail. NF: (L) Near edge of airstrip. F1-413.
- E. variegatum Schleich. ex Fried. Weber & Mohr, SF: (L) Dunes and shores. 3361, 3800. NF: (L) Borrow pits. 3331, 3990.

#### LYCOPODIACEAE (Clubmoss Family)

- Lycopodium annotinum L., Stiff Clubmoss. NF: (F) Northern hardwoods. 3328.
- L. dendroideum Michaux, Round-branch Ground-pine. SF: (O) Northern hardwoods. 4656. NF: (F) Northern hardwoods. 3290, 4606.
- L. lucidulum Michaux, Shining Clubmoss. SF: (F) Moist northern hardwoods. 3842. NF: (F) Northern hardwoods. 3322; FI-309; Test.
- L. obscurum L., Tree Clubmoss. SF: (O) Northern hardwoods. FI-157. NF: (F) Moist northern hardwoods. 3297, 3984, 3985; FI-456.

#### OPHIOGLOSSACEAE (Adder's Tongue Family)

- Botrychium campestre W. H. Wagner & Farrar, Dunewort. SF: (R) Perched dunes. 3126. Michigan threatened species.
- B. matricariifolium A. Braun, Daisy-leaved Moonwort. SF: (C) Near edges of airstrip and old fields. 3374, 3383, 4027. NF: (F) Airstrip. 3999.
- B. minganense Vict., Mingan Moonwort. SF: (L) Woods bordering old field, NE 1/4 of Sec. 5. 3384.
- B. multifidum (Gmelin) Rupr., Leathery Grape Fern. SF: (L) Airstrip and old fields. 3855, 4658; FI-230. NF: (L) Airstrip. 3753.
- B. simplex E. Hitchc., Least Moonwort. SF: (L) Airstrip. 4030.
- B. virginianum (L.) Sw., Rattlesnake Fern. SF: (C) Northern hardwoods. 3382; FI-159; Wolf. NF: (C) Northern hardwoods. FI-310.
- Ophioglossum pusillum Raf. [O. vulgatum L.], Adder's Tongue. NF: (L) Airstrip. 3725.

#### OSMUNDACEAE (Royal Fern Family)

Osmunda cinnamomea L., Cinnamon Fern. NF: (F) Wet northern hardwoods. 3327. O. regalis L., Royal Fern. NF: (L) Wet northern hardwoods. FI-457.

#### POLYPODIACEAE [sensu lato] (Fern Family)

- Adiantum pedatum L., Maidenhair Fern. SF: (F) Northern hardwoods. FI-108; Clover. NF: (F) Northern hardwoods. FI-285.
- Asplenium viride Hudson [A. trichomanes-ramosum L.], Green Spleenwort. SF: (L) Interdunal valleys bordering perched dunes and in nearby northern hardwoods. FI-114: Test. Michigan special concern species.
- Athyrium filix-femina (L.) Roth, Lady Fern. SF: (C) Northern hardwoods. F1-173; Clover. NF: (C) Northern hardwoods. F1-438.
- Cystopteris bulbifera (L.) Bernh., Bulblet Fern. SF: (F) Moist northern hardwoods and interdunal valleys. FI-111; Clover. NF: Test.
- C. tenuis (Michaux) Desv., Fragile Fern. SF: (L) Northern hardwoods, Sec. 33. 3378a.

- Dryopteris carthusiana (Villars) H. P. Fuchs [D. spinulosa (Mueller) Watt.], Spinulose Wood Fern. SF: (C) Northern hardwoods. 4036. NF: (C) Moist northern hardwoods. 3298, 3698; Test.
- D. cristata (L.) A. Gray, Crested Shield Fern. SF: Clover. NF: (L) Edge of pool inside lowland conifer forest. 4631.
- D. intermedia (Muhlenb.) A. Gray, Evergreen Wood Fern. SF: (F) Northern hardwoods. 3340. NF: (F) Northern hardwoods. FI-317.
- D. marginalis (L.) A. Gray, Marginal Wood Fern. SF: (C) Northern hardwoods. FI-69. NF: (C) Northern hardwoods. FI-293; Test.
- D. xtriploidea Wherry, SF: (O) Northern hardwoods. 4038. NF: (O) Northern hardwoods. 3966.
- Gymnocarpium dryopteris (L.) Newman, Oak Fern. SF: (L) Moist northern hardwoods bordering waterhole field. 3781. NF: (O) Lowland conifer forest. 3102.
- Matteuccia struthiopteris (L.) Todaro, Ostrich Fern. SF: (L) Moist shaded swale west of airstrip. 3130; FI-184; Clover. NF: (L) Wet northern hardwoods. FI-305.
- Onoclea sensibilis L., Sensitive Fern. SF: (O) Moist northern hardwoods bordering waterhole field. 3336. NF: (F) Wet northern hardwoods. FI-376; Test.
- Polypodium virginianum L., Common Polypody. SF: (L) Northern hardwoods. FI-76; Clover; Wolf. NF: (O) Northern hardwoods. 3319, 3977; FI-284.
- Polystichum acrostichoides (Michaux) Schott, Christmas Fern. SF: (L) Northern hardwoods west of airstrip. FI-195; Clover; Test. NF: Test.
- P. braunii (Spenner) Feé, Braun's Holly Fern. SF: (L) Interdunal valley bordering perched dunes, Sec. 32. FI-106.
- P. lonchitis (L.) Roth, Northern Holly Fern. SF: (L) Interdunal valley bordering perched dunes, Sec. 32. 3117.
- Pteridium aquilinum (L.) Kuhn, Bracken Fern. SF: (C) Old fields and shores. FI-17. NF: (F) Open sites and shores. 3686, 3995.
- Thelypteris palustris Schott, Marsh Fern. NF: (C) Wet northern hardwoods. FI-458.
- T. phegopteris (L.) Slosson, Northern Beech Fern. SF: (L) Northern hardwoods at north end of island. FI-239. NF: (L) Wet northern hardwoods south of airstrip. 3713.

#### **GYMNOSPERMS**

#### CUPRESSACEAE (Cypress Family)

- Juniperus communis L., Common Juniper. SF: (C) Shores and dunes. FI-97. NF: (F) Shores and dunes. FI-258.
- J. horizontalis Moench, Creeping Juniper. SF: (C) Shores and dunes. FI-67; Clover. NF: (F) Shores and dunes. FI-269.
- J. virginiana L., NF: (R) One individual on lake bluff on island's west side. Slid into Lake Michigan in 1987. 3997; FI-415.
- Thuja occidentalis L., White Cedar. SF: (C) Woods bordering dunes and shores. FI-42; Clover. NF: (C) Lowland conifer forest. FI-257.

#### PINACEAE (Pine Family)

- Abies balsamea (L.) Miller, Balsam Fir. SF: (F) Woods bordering dunes and shores. FI-35; Test. NF: (F) Lowland conifer forest and woods bordering dunes and shores. FI-267.
- Larix laricina (Duroi) K. Koch, Larch. NF: (L) Gravel beach along north shore. 4009.
  Picea glauca (Moench) A. Voss, White Spruce. SF: (L) Woods bordering dunes on east side, Sec. 33. 3148.
- Pinus strobus L., White Pine. SF: (R) Wooded dune blowout, Sec. 32. 3799. NF: (R) Woods bordering shore north of blowout. 3083.

#### TAXACEAE (Yew Family)

Taxus canadensis Marshall, Yew. SF: (C) Northern hardwoods and woods bordering dunes and shores. FI-68; Clover; Wolf. NF: (F) Northern hardwoods. FI-286.

#### **MONOCOTYLEDONS**

#### ARACEAE (Arum Family)

Arisaema triphyllum (L.) Schott, Jack-in-the-pulpit. SF: (C) Northern hardwoods. FI-160; Clover; Wolf. NF: (C) Northern hardwoods. FI-428; Test.

Symplocarpus foetidus (L.) Nutt., Skunk-cabbage. SF: (L) Swale west of airstrip. 3128. NF: (C) Wet northern hardwoods. 3086; FI-327.

#### COMMELINACEAE (Spiderwort Family)

Tradescantia virginiana L., SF: (L) Persisting at lighthouse area. 3819.

#### CYPERACEAE (Sedge Family)

Carex albursina E. Sheldon, NF: (L) Wet northern hardwoods along trail south of airstrip. FI-343.

C. aquatilis Wahlenb., NF: (L) Lowland conifer forest. 3734.

C. arctata Boott, SF: Wolf. NF: (O) Northern hardwoods. 3292; FI-431.

- C. aurea Nutt., SF: (L) Waterhole in field, Sec. 32. FI-154. NF: (L) Airstrip and nearby borrow pits. 3992; FI-366.
- C. bebbii (L. Bailey) Fern., SF: (L) Waterhole in field, Sec. 32. 4644. NF: (L) Wet northern hardwoods south of airstrip. FI-369, FI-459.
- C. brunnescens (Pers.) Poiret, NF: (L) Northern hardwoods north of airstrip. 3079.

C. canescens L., NF: (L) Northern hardwoods south of airstrip. 4006.

- C. cephaloidea (Dewey) Dewey, SF: (L) Northern hardwoods at north end of island. 3342.
- C. communis L. Bailey, NF: (O) Northern hardwoods. 3080; FI-302.
- C. deweyana Schwein., SF: (O) Northern hardwoods. 4013; FI-83; Clover. NF: (O) Northern hardwoods and lowland conifer forest. 4630, 4633; FI-443, FI-445, [FI] 84322.
- C. eburnea Boott, SF: (F) Woods bordering perched dunes. FI-115. NF: (F) Woods near blowout and along airstrip and nearby borrow pits. 3991, 4004; FI-283.

C. garberi Fern., SF: (L) Old fields. 4029. NF: (L) Blowout. 3284.

- C. gracillima Schwein., SF: (O) Northern hardwoods. Clover. NF: (O) Northern hardwoods. 3326; FI-349.
- C. houghtoniana Dewey, SF: (L) Airstrip. 4034.
- C. hystericina Willd., NF: (O) Airstrip. FI-399, FI-408; Test.
- C. intumescens Rudge, SF: (L) Moist northern hardwoods bordering waterhole field. 3785. NF: (C) Wet northern hardwoods. 3300, 3323, 3702, 3717; FI-351, FI-461.
- C. laevivaginata (Kük.) Mackenzie, NF: (L) Wet northern hardwoods along trail south of airstrip. [FI] 84340.
- C. leptonervia Fern., SF: (C) Northern hardwoods. 4012; FI-130, FI-158, FI-175.
- C. lupulina Willd., SF: (F) Moist northern hardwoods. 3388, 3786. NF: (F) Moist northern hardwoods and along airstrip. 3313; FI-353, FI-380b.
- C. plantaginea Lam., SF: (L) Northern hardwoods at north end of island. 4022. NF: Test.
- C. praegracilis W. Boott, NF: (L) Airstrip. FI-411.
- C. prasina Wahlenb., SF: (L) Moist shaded swale west of airstrip. 3387, 4659.
- C. projecta Mackenzie, SF: (L) Moist northern hardwoods bordering waterhole field. 3789.
- C. radiata (Wahlenb.) Dewey, SF: (L) Moist northern hardwoods bordering waterhole field. 3351. NF: (O) Northern hardwoods. 3288; FI-350.
- C. retrorsa Schwein., NF: (O) Northern hardwoods. F1-380a; Test.
- C. rosea Willd., SF: (O) Northern hardwoods. 4638; FI-131, FI-174; Clover. NF: (O) Northern hardwoods. 3970.
- C. sprengelii Sprengel, SF: (O) Northern hardwoods. 3341, 4037. NF: (O) Northern hardwoods. FI-314.
- C. stipata Willd., SF: (L) Moist northern hardwoods bordering waterhole field. 3352.
- C. tuckermanii Dewey, SF: (L) Moist northern hardwoods bordering waterhole field. 3348, 3792. NF: (O) Moist northern hardwoods. 3329, 4599; FI-352, [FI] 84333.

C. umbellata Willd., SF: (L) Perched dunes. 3123.

C. vesicaria L., NF: (O) Wet northern hardwoods. 3703.

C. viridula Michaux, SF: (L) Dune pools of dunes on east side, Sec. 33. 3803. NF: (O) Airstrip and nearby borrow pits. 3993; FI-365; Test.

C. vulpinoidea Michaux, SF: (L) Moist northern hardwoods bordering waterhole field. 3783; FI-153. NF: (O) Airstrip. FI-410.

Eleocharis elliptica Kunth, NF: (L) Airstrip. 3311; FI-368, FI-391.

E. pauciflora (Light.) Link, SF: (L) Dune pools of dunes on east side, Sec. 33. 3801.

E. rostellata Torrey, NF: (L) Borrow pit at east end of airstrip. 4619.

Scirpus atrovirens Willd., NF: (L) Airstrip. 4613.

S. cyperinus (L.) Kunth, SF: (L) Moist northern hardwoods bordering waterhole field. 3787, 3836. NF: (L) Airstrip. FI-382.

S. pendulus Muhlenb., NF: (L) Borrow pit at east end of airstrip. 4621.

S. validus Vahl, NF: (L) Borrow pit at east end of airstrip. 4620.

#### GRAMINEAE [POACEAE] (Grass Family)

Agropyron dasystachyum (Hook.) Scribner, SF: (F) Shores. FI-23. NF: (O) Dunes and shores. FI-273; Test.

A. repens (L.) P. Beauv., Quackgrass. SF: (F) Dunes and shores and old fields. 3371; FI-14, FI-94.

A. trachycaulum (Link) Malte, NF: (L) Beach, southwest side. 4604; FI-454.

Agrostis gigantea Roth, Redtop. SF: (O) Old fields and moist northern hardwoods. 3788, 4663; FI-98, FI-137; Wolf. NF: (O) Airstrip. 4609a; FI-409.

A. stolonifera L., SF: (F) Airstrip. FI-182.

Ammophila breviligulata Fern., Beach Grass. SF: (C) Dunes and shores. FI-44. NF: (F) Dunes. FI-321.

Andropogon scoparius Michaux, Little Bluestem. SF: (F) Dunes. FI-203.

Bromus inermis Leysser, Smooth Brome. SF: (F) Old fields. FI-55; Clover.

B. pumpellianus Scribner, Pumpelly's Bromegrass SF: (L) Perched dunes. FI-105, FI-202. NF: (L) Blowout. 3689. Michigan threatened species.

Calamagrostis canadensis (Michaux) P. Beauv., Blue-joint. NF: (O) Wet northern hardwoods. 3701, 4598, 4628.

Calamovilfa longifolia (Hook.) Scribner, SF: (C) Dunes and shores, and some old fields. FI-181. NF: (F) Dunes. FI-254.

Dactylis glomerata L., Orchard Grass. SF: (F) Old fields. FI-209. NF: (O) Shores. FI-455.

Danthonia spicata (L.) Roemer & Schultes, Oatgrass. SF: (O) Old fields. 4664.

Elymus canadensis L., SF: (F) Dunes and shores. FI-213; Clover. NF: (F) Dunes and shores. FI-453; Test.

Eragrostis spectabilis (Pursh) Steudel, Tumble Grass. SF: (L) Airstrip. 3829.

Festuca obtusa Biehler, Nodding Fescue. SF: (L) 3343, Clover. NF: (L) Northern hardwoods behind blowout. 3695; FI-303.

F. ovina L., Sheep Fescue. SF: (L) Airstrip. 4035.

F. rubra L., NF: (O) Shaded trails. 3289; Test.

F. saximontana Rydb., SF: (L) Dunes on east side, Sec. 33. 3353, 4017, 4653. NF: (L) Blowout. 3690.

Glyceria striata (Lam.) A. Hitchc., Fowl Manna Grass. SF: (O) Moist northern hardwoods. 3784, 4660; FI-198. NF: (L) Edge of pool inside lowland conifer forest. 4624; [FI] 84338.

Hystrix patula Moench, Bottlebrush Grass. SF: (O) Northern hardwoods. FI-132. NF: (O) Northern hardwoods. FI-346.

Koeleria macrantha (Ledeb.) Schultes, June Grass. SF: (O) Dunes. FI-103.

Melica smithii (A. Gray) Vasey, SF: (F) Northern hardwoods. 3346, 4021. NF: (F) Northern hardwoods. 3967.

Milium effusum L., SF: (C) Northern hardwoods. 3347; F1-81. NF: (C) Northern hardwoods. F1-315; Test.

Oryzopsis asperifolia Michaux, SF: Clover. NF: (L) Lowland conifer forest. Sight identification.

Panicum columbianum Scribner, SF: (L) Old fields. 3380.

P. implicatum Britton, SF: (F) Dunes. 3794, 3802. NF: (O) Airstrip. 4612; FI-362, FI-389, FI-407.

P. miliaceum L., Proso. SF: (L) Lumber camp. 4657.

Phalaris arundinacea L., Reed Canary Grass. NF: Test.

Phleum pratense L., Timothy. SF: (C) Old fields and shores. FI-1. NF: (C) Airstrip. FI-396; Test.

Poa compressa L., Canada Bluegrass. SF: (C) Old fields and shores. 3852; FI-56, FI-168, FI-183. NF: (C) Shady trails and shores. 3286; FI-277, FI-452; Test.

P. nemoralis L., NF: (L) Woods near blowout. FI-297.

P. palustris L., Fowl Meadow Grass. SF: (L) Shaded trail at north end of island. 4646.
NF: (O) Wet northern hardwoods and lowland conifer forest. 3736, 4605; FI-276; Test.

P. pratensis L., SF: (O) Shaded trails. 3372, 3377, 4019, 4024. NF: (O) Shaded trails. 3285, 3287, 3692.

Schizachne purpurascens (Torrey) Swallen, False Melic. SF: (O) Shady trails. 3390; FI-205. NF: (L) Shady trails. 3988.

# IRIDACEAE (Iris Family)

Iris pallida Lam., SF: (L) Persisting at lighthouse area. 4028.

I. virginica L., Southern Blue Flag. NF: (O) Airstrip. 3307; FI-394.

Sisyrinchium montanum E. Greene, Blue-eyed-grass. NF: (L) Airstrip. 4769.

# JUNCACEAE (Rush Family)

Juncus alpinus Villars, SF: (L) Dune pools of dunes on east side, Sec. 33 and near waterhole in field, Sec. 32. 3806; FI-151. NF: (L) Airstrip. FI-392; Test.

J. articulatus L., SF: (L) Near waterhole in field, Sec. 32. FI-148.

J. balticus Willd., SF: (C) Dunes and shores. 3808; FI-102, FI-155. NF: (C) Airstrip and dunes and shores. FI-390; Test.

J. dudleyi Wieg., SF: (L) Near waterhole in field, Sec. 32. FI-150.

J. nodosus L., SF: (L) Near waterhole in field, Sec. 32. FI-149. NF: (L) Airstrip. 3726; FI-395.

J. tenuis Willd., SF: Clover. NF: (O) Northern hardwoods. FI-440; Test.

# JUNCAGINACEAE (Arrow-grass Family)

Triglochin palustre L., SF: (L) Dunes on east side, Sec. 33. 3804.

# LEMNACEAE (Duckweed Family)

Lemna minor L., Duckweed. NF: (L) Pool in lowland conifer forest near gravel beach along north shore. 3738.

#### LILIACEAE (Lily Family)

Allium tricoccum Aiton, Wild Leeks. SF: (C) Northern hardwoods. FI-84; Clover; Wolf. NF: (C) Northern hardwoods. FI-295; Test.

Asparagus officinalis L., Garden Asparagus. SF: (L) Persisting at lumber camp, recent escape. 3851.

Clintonia borealis (Aiton) Raf., Corn-lily. SF: (O) Northern hardwoods and woods bordering dunes and shores. 3826. NF: (F) Northern hardwoods and lowland conifer forest. FI-292.

Convallaria majalis L., Lily-of-the-valley. SF: (L) Persisting at lighthouse area. 3367. Erythronium americanum Ker Gawler, Adder's-tongue. SF: (C) Northern hardwoods. 3104. NF: (C) Northern hardwoods. 3076.

Lilium philadelphicum L., Wood Lily. SF: (C) Dunes and shores. 3362; FI-104; Test; Wolf. NF: (F) Dunes and shores. FI-449.

Maianthemum canadense Desf., Canada Mayflower. SF: (C) Northern hardwoods and woods bordering dunes and shores. FI-123; Clover; Wolf. NF: (C) Northern hardwoods and woods bordering dunes and shores. FI-348.

Polygonatum pubescens (Willd.) Pursh, Hairy Solomon's Seal. SF: (C) Northern hardwoods. FI-142; Clover; Wolf. NF: (C) Northern hardwoods. 3968; FI-342.

Smilacina racemosa (L.) Desf., False Spikenard. SF: (C) Northern hardwoods. FI-133; Clover. NF: (C) Northern hardwoods. FI-425.

S. stellata (L.) Desf., Starry False Solomon's Seal. SF: (C) Dunes and shores. FI-25; Clover. NF: (C) Dunes and shores. FI-250; Test.

Streptopus roseus Michaux, Rose Twisted-stalk. SF: (F) Northern hardwoods. 3141; F1-240; Wolf. NF: (F) Northern hardwoods. FI-439.

Trillium cernuum L., Nodding Trillium. SF: (O) Northern hardwoods. 3106; FI-138, FI-238. NF: (L) Lowland conifer forest. 4010.

T. erectum L., Stinking Benjamin. SF: (L) Northern hardwoods at north end of island. 3110; F1-139. NF: Test.

T. flexipes Raf., SF: (L) Northern hardwoods at north end of island. 3109. NF: (O) Northern hardwoods. 3087, 3963, 4770.

T. grandiflorum (Michaux) Salisb., Common Trillium. SF: (C) Northern hardwoods. 3143; FI-140; Wolf. NF: (C) Northern hardwoods. 3097.

Zigadenus glaucus (Nutt.) Nutt., White Camas. SF: (F) Dunes and shores. FI-52; Clover; Wolf. NF: (F) Dunes and shores. FI-245.

#### ORCHIDACEAE (Orchid Family)

Calypso bulbosa (L.) Oakes, Calypso. NF: (F) Lowland conifer forest. 3070. Michigan threatened species.

Corallorhiza maculata (Raf.) Raf., Spotted Coral-root. SF: (O) Woods bordering dunes and shores. 3796; Clover.

C. striata Lindley, Striped Coral-root. NF: (F) Lowland conifer forest. 3064.

C. trifida Châtel., Early Coral-root. NF: (L) Lowland conifer forest. 4011.

Cypripedium calceolus L., Yellow Lady-slipper. SF: (O) Woods bordering dunes on east side, Sec. 33. 4018; FI-127; Wolf.

Epipactis helleborine (L.) Crantz, Helleborine. SF: (O) Northern hardwoods. 3843.

Goodyera oblongifolia Raf., Giant Rattlesnake-plantain. SF: (O) Woods bordering perched dunes. 3797, Wolf. NF: (F) Lowland conifer forest. 3709, 3729a.

G. repens (L.) R. Br., Dwarf Rattlesnake-plantain. SF: (O) Woods bordering perched dunes. 3798; FI-120; Wolf. NF: (L) Lowland conifer forest. 4623.

G. tesselata Lodd., Checkered Rattlesnake-plantain. NF: (O) Lowland conifer forest. 3729.

Habenaria clavellata (Michaux) Sprengel [Platanthera clavellata (Michaux) Luer], Club-spur Orchid. NF: (O) Wet northern hardwoods. 3718.

H. hyperborea (L.) R. Br. [Platanthera hyperborea (L.) Lindley], Tall Northern Bog Orchid. SF: (L) Waterhole in field, Sec. 32. FI-145. NF: (F) Wet northern hardwoods, along airstrip, and gravel beach of north shore. 3306, 3330, 3721, 3742; FI-328, FI-379.

H. orbiculata (Pursh) Torrey [Platanthera orbiculata (Pursh) Lindley], Round-leaved Orchid. SF: (O) Northern hardwoods. Wolf. NF: (O) Northern hardwoods. 3321.

H. viridis (L.) R. Br. [Coeloglossum viride (L.) Hartman], Long-bracted Green Orchid. SF: (F) Northern hardwoods. 3127; FI-189; Wolf. NF: (O) Northern hardwoods. FI-378.

Liparis loeselii (L.) Rich., Fen Orchid. SF: (L) Near waterhole in field, Sec. 32. 3333, 3771.

Listera convallarioides (Sw.) Torrey, Broad-leaved Twayblade. NF: (O) Wet northern hardwoods. 3320, 3719.

Malaxis monophylla (L.) Sw., NF: (L) Airstrip. FI-412.

Spiranthes cernua (L.) Rich., NF: (L) Airstrip. 3724a.

S. romanzoffiana Cham., NF: (L) Airstrip. 3724.

#### POTAMOGETONACEAE (Pondweed Family)

Potamogeton foliosus Raf., SF: (L) In waterhole in field, Sec. 32. 3762.

P. gramineus L., SF: (L) Dune pools of dunes on east side, Sec. 33. 3805. NF: (L) Airstrip and pool in lowland conifer forest near gravel beach. 4617.

# SPARGANIACEAE (Bur-reed Family)

Sparganium angustifolium Michaux, NF: Test.

# TYPHACEAE (Cat-tail Family)

Typha latifolia L., Common Cat-tail. SF: (L) Moist shaded swale west of airstrip. 3833. NF: (L) Airstrip. FI-397.

#### **DICOTYLEDONS**

# ACERACEAE (Maple Family)

Acer negundo L., Box-elder. SF: (L) Recent escape, lighthouse area. 3816.

- A. pensylvanicum L., Striped Maple. NF: (O) Northern hardwoods. FI-426.
- A. rubrum L., Red Maple. SF: (R) Woods bordering beach north of lumber camp. 4039. NF: (C) Wet northern hardwoods. 3084.
- A. saccharum Marshall, Sugar Maple. SF: (C) Northern hardwoods. FI-41. NF: (C) Northern hardwoods. 3281.
- A. spicatum Lam., Mountain Maple. SF: (F) Northern hardwoods. FI-74; Clover; Wolf. NF: (F) Northern hardwoods. Test; FI-268.

# AMARANTHACEAE (Amaranthus Family)

Amaranthus albus L., Tumbleweed. SF: (L) Disturbed ground near lumber camp. 3848, 3849; FI-214.

# ANACARDIACEAE (Cashew Family)

Rhus ×pulvinata E. Greene, SF: (L) Old field near lumber camp. 3844; FI-48; Clover. R. typhina L., Staghorn Sumac. SF: (F) Old fields. 3825, 3830.

Toxicodendron radicans (L.) Kuntze, Poison-ivy. SF: (F) Dunes and shores, and some old fields. FI-228. NF: (F) Dunes and shores. 3750.

#### APOCYNACEAE (Dogbane Family)

Apocynum androsaemifolium L., Spreading Dogbane. SF: (O) Old fields. 4642. NF: (O) Shores. 4603.

#### AQUIFOLIACEAE (Holly Family)

*Ilex verticillata* (L.) A. Gray, Michigan Holly. NF: (O) Wet northern hardwoods. *3325*; *Test*.

#### ARALIACEAE (Ginseng Family)

Aralia hispida Vent., Bristly Sarsaparilla. SF: Clover. NF: (L) Northern hardwoods. FI-433.

- A. nudicaulis L., Wild Sarsaparilla. SF: (C) Northern hardwoods. FI-79; Clover. NF: (F) Northern hardwoods. FI-418.
- A. racemosa L., Spikenard. SF: (C) Northern hardwoods. FI-8; Clover; Wolf. NF: (F) Northern hardwoods. FI-336; Test.

Panax quinquefolius L., Ginseng. SF: (L) Interdunal valleys bordering perched dunes. FI-118, FI-128; Clover. Michigan threatened species.

# ASCLEPIADACEAE (Milkweed Family)

Asclepias syriaca L., Common Milkweed. SF: (C) Dunes and shores, and some old fields. FI-9. NF: (F) Airstrip, dunes and shores. FI-289, FI-359.

A. viridiflora Raf., Green Milkweed. SF: (L) Perched dunes. FI-125.

# BALSAMINACEAE (Touch-me-not Family)

Impatiens capensis Meerb., Spotted Touch-me-not. SF: (L) Moist shaded swale west of airstrip. 3832. NF: (F) Wet northern hardwoods. 3697; F1-307.

# BERBERIDACEAE (Barberry Family)

Caulophyllum thalictroides (L.) Michaux, Blue Cohosh. SF: (F) Northern hardwoods. FI-141. NF: (F) Northern hardwoods. FI-329; Test.

BETULACEAE (Birch Family)

Betula alleghaniensis Britton, Yellow Birch. SF: (O) Northern hardwoods. FI-234. NF: (C) Northern hardwoods and lowland conifer forest. FI-423.

B. papyrifera Marshall, White Birch. SF: (C) Northern hardwoods and woods bordering dunes and shores. FI-34. NF: (C) BTH sight ident.; Test.

Corylus cornuta Marshall, Beaked Hazelnut. SF: (F) Northern hardwoods. FI-40. NF: (F) Northern hardwoods. FI-422; Test.

Ostrya virginiana (Miller) K. Koch, Ironwood. SF: (C) Northern hardwoods. FI-39. NF: (C) Northern hardwoods. FI-274.

BORAGINACEAE (Forget-me-not Family)

Cynoglossum officinale L., Common Hound's-tongue. SF: (F) Shaded trails. FI-190; Test.

Hackelia deflexa (Wahlenb.) Opiz., SF: (O) Shaded trails. 3357, 4637.

Lithospermum caroliniense (Walter) MacMillan, Puccoon. SF: (C) Dunes and shores. 3360; FI-51; Clover; Wolf. NF: (F) Dunes and shores. FI-244; Test.

Myosotis laxa Lehm., SF: (L) Test.

BUXACEAE (Boxwood Family)

Pachysandra terminalis Siebold & Zucc., SF: (L) Planted at lumber camp; extirpated in cookhouse fire, Nov. 1985. 3847.

CAMPANULACEAE (Harebell Family)

Campanula rotundifolia L., Harebell. SF: (C) Dunes and shores. FI-63; Wolf. NF: (F) Dunes and shores. FI-248.

C. rapunculoides L., SF: (L) Recent escape, lighthouse area. 3820a.

CAPRIFOLIACEAE (Honeysuckle Family)

Diervilla lonicera Miller, Bush Honeysuckle. SF: (F) Woods bordering dunes and shores. FI-46; Wolf. NF: (F) Woods bordering dunes and shores. FI-281; Test.

Linnaea borealis L., Twinflower. SF: (F) Woods bordering dunes and shores. 4775; FI-122; Wolf. NF: (F) Lowland conifer forest. 3294, 4767.

Lonicera canadensis Marshall, Fly Honeysuckle. SF: (O) Northern hardwoods. 3114; FI-117. NF: (O) Northern hardwoods. 3072; FI-430.

L. dioica L., Wild Honeysuckle. SF: (O) Northern hardwoods. FI-11; Wolf. NF: (O) Northern hardwoods. FI-264.

L. hirsuta Eaton, Hairy Honeysuckle. SF: (O) Airstrip. 3841; Clover. NF: (L) Woods bordering dunes and shores. 4602.

Sambucus pubens Michaux, SF: (C) Northern hardwoods. FI-164; Clover; Wolf. NF: (C) Northern hardwoods. FI-272.

Symphoricarpos albus (L.) S. F. Blake, Snowberry. SF: (F) Northern hardwoods. FI-6. NF: (F) Northern hardwoods. FI-447.

Viburnum acerifolium L., Maple-leaved Viburnum. SF: (F) Clover.

V. trilobum Marshall, Highbush Cranberry. SF: (F) Northern hardwoods. 3363; F1-37; Test. NF: (O) Northern hardwoods. 3314, 4596; F1-398; Test.

#### CARYOPHYLLACEAE (Pink Family)

Arenaria serpyllifolia L., Thyme-leaved Sandwort. SF: (F) Airstrip and old fields. 3780, FI-215. NF: (F) Shaded trails. 3710, 3962; FI-288.

A. stricta Michaux, Rock Sandwort. SF: (O) Dunes. 4014. NF: (O) Dunes. 3961.

Cerastium fontanum Baumg., Common Mouse-eared Chickweed. SF: (C) Shaded trails. FI-86, FI-172; Wolf. NF: (F) Shaded trails and dunes. FI-331; Test.

Dianthus armeria L., Deptford Pink. SF: (L) Airstrip. FI-364.

D. barbatus L., Sweet William. SF: (L) Recent escape, lighthouse area. FI-90.

Saponaria officinalis L., Bouncing Bet. SF: (O) Old fields. 4651.

Silene antirrhina L., Sleepy Catchfly. SF: (L) Airstrip. 4033.

S. noctiflora L., Night-flowering Catchfly. SF: Clover.

S. pratensis (Rafn) Godron & Gren., White Campion. SF: (F) Old fields. FI-217. NF: (R) Shaded trails. 4609.

S. vulgaris (Moench) Garcke, Bladder Campion. SF: (F) Old fields and shores. FI-5. NF: (O) Test.

Stellaria calycantha (Ledeb.) Bong., Northern Starwort. NF: (L) Shaded trails. FI-432.

S. graminea L., Common Stitchwort. SF: (L) Old fields. 3335. NF: (L) Airstrip. FI-400.

S. media (L.) Villars, Common Chickweed. SF: (F) Shaded trails. F1-188.

# CELASTRACEAE (Staff-tree Family)

Celastrus scandens L., Bittersweet. SF: (O) Woods bordering dunes and shores. 3815; F1-24. NF: (L) Edge of blowout. 4595.

# CHENOPODIACEAE (Goosefoot Family)

Chenopodium album L., Lambs-Quarters. SF: (O) Open disturbed sites. 3764.

C. capitatum (L.) Asch., Strawberry Blite. SF: (O) Shaded trails and logging sites. 4040, 4639; Wolf. NF: (L) Shaded trails. FI-462; Test.

C. hybridum L., SF: (O) Shaded trails. 4645.

Corispermum hyssopifolium L., Bugseed. SF: (L) Blowout. F1-201. NF: (L) Blowout. 3693.

# CISTACEAE (Rockrose Family)

Hudsonia tomentosa Nutt., Beach Heath. SF: (L) Lag gravel area near south end of island. FI-65.

# COMPOSITAE [ASTERACEAE] (Composite Family)

Achillea millefolium L., Common Yarrow. SF: (F) Old fields and shores. FI-3. NF: (O) Shores. FI-323; Test.

Ambrosia artemisiifolia L., Common Ragweed. SF: (O) Old fields. 4652.

A. psilostachya DC., SF: (O) Old fields. 3763.

Anaphalis margaritacea (L.) Benth. & Hook., Pearly Everlasting. SF: (F) Woods bordering dunes and shores. FI-4. NF: (F) Shores. 3706; FI-357.

Antennaria neglecta E. Greene, Field Pussytoes. SF: (F) Old fields. 3134. NF: (F) Shores. 3103: 3998.

A. plantaginifolia (L.) Richardson, SF: (O) Old fields. 4031.

Arctium minus Schk., Common Burdock. SF: (L) Shaded trails. FI-170; Wolf. NF: (L) Shaded trails. 4607.

Artemisia biennis Willd., SF: (L) Old field, SE 1/4 of Sec. 32. 4648.

A. caudata Michaux, Tall Wormwood. SF: (C) Dunes and shores. FI-19; Clover. NF: (F) Dunes and shores. FI-249; Test.

Aster laevis L., SF: (F) Dunes. FI-126, FI-200.

A. lateriflorus (L.) Britton, SF: (O) Moist northern hardwoods. 3838. NF: (O) Wet northern hardwoods. 3699.

A. macrophyllus L., Large-leaved Aster. SF: (C) Woods bordering dunes and shores. 3811; FI-10; Wolf. NF: (F) Woods bordering dunes and shores. 3708; FI-371; Test.

A. simplex Willd., Panicled Aster. SF: (O) Perched dunes. 3793. NF: (O) Shores. 3745. Centaurea maculosa Lam., Spotted Knapweed. SF: (F) Old fields. FI-232. NF: (L)

Disturbed ground near Walter house. 3746.

Chrysanthemum leucanthemum L., Ox-eye Daisy. SF: (C) Old fields and shores. FI-16. Cirsium arvense (L.) Scop., Canada Thistle. SF: (O) Old fields. 3772; FI-225. NF: (F) Airstrip. 3757; FI-356, FI-463.

C. pitcheri (Torrey) Torrey & A. Gray, Pitcher's Thistle. SF: (C) Dunes and shores. FI-28; Clover; Wolf. NF: (F) Dunes and shores. FI-332; Test. US and Michigan threatened species.

C. vulgare (Savi) Tenore, Bull Thistle. SF: (L) Shaded trails. 4641. NF: (L) Airstrip.

Conyza canadensis (L.) Cronq., Hog Weed. SF: (O) Old fields. 3828. NF: (L) Shaded trails. 3694.

Coreopsis lanceolata L., Lance-leaved Coreopsis. SF: (C) Dunes and shores. 3359; F1-45; Clover, NF: (F) Dunes and shores. FI-416.

Erigeron annuus (L.) Pers., SF: (O) Shaded trails. FI-161. NF: (O) Airstrip. FI-406.

E. philadelphicus L., SF: (F) Shaded trails. 3378; FI-109. NF: (O) Airstrip. 3306a, 3994; FI-344.

E. strigosus Muhlenb., SF: (O) Old fields. 3854. NF: (O) Airstrip. 3759.

Eupatorium maculatum L., Joe-pye-weed. NF: (L) Wet northern hardwoods. FI-460. Hieracium aurantiacum L., Orange Hawkweed. SF: (F) Old fields. FI-29. NF: (O) Airstrip. FI-402.

H. canadense Michaux, SF: (L) Woods north of lumber camp. 4654.

H. piloselloides Villars, SF: (F) Old fields. 3375. NF: (F) Airstrip. FI-373.

Lactuca canadensis L., SF: (O) Shaded trails. 4634. NF: (O) Shaded trails and airstrip. 3711; FI-361.

Prenanthes alba L., White Lettuce. SF: (F) Woods bordering dunes and shores. FI-179; Clover; Wolf.

Rudbeckia hirta L., Black-eyed Susan. SF: (F) Old fields. FI-91.

Senecio pauperculus Michaux, Balsam Ragwort. SF: (F) Shores. FI-60.

Solidago canadensis L., Canada Goldenrod. SF: (F) Old fields. 3765. NF: (O) Airstrip. 3722.

S. flexicaulis L., Zig-zag Goldenrod. SF: (C) Northern hardwoods. 3767, 3853; FI-119; Wolf. NF: (C) Northern hardwoods. 3712; FI-308.

S. gigantea Aiton, SF: (C) Old fields. 3773, 3814, 3831. NF: (C) Shores. 3685, 3732, 3751.

S. graminifolia (L.) Salisb., Grass-leaved Goldenrod. NF: (L) Airstrip and blowout. 3696; FI-367.

S. juncea Aiton, SF: (L) Old field east of airstrip. FI-206.

S. nemoralis Aiton, Gray Goldenrod. SF: (F) Dunes. 3795; FI-124.

S. ohioensis Riddell, NF: (L) Gravel beach along north shore. 3743.

S. spathulata DC., SF: (F) Dunes and shores. 3810. NF: (F) Dunes and shores. 3687, 3691, 3749, 4593; FI-255.

Sonchus arvensis L., NF: (L) Airstrip. FI-405.

S. uliginosus M. Bieb., NF: (L) Airstrip. 3720.

Tanacetum huronense Nutt., Huron Tansy. SF: (L) Dunes on east side, Sec. 33. 3354. NF: (L) Gravel beach along north shore. 3315; Test. Michigan threatened species.

Taraxacum officinale Weber, Dandelion. SF: (C) Old fields. FI-242. NF: (F) Shaded trails. FI-334.

Tragopogon dubius Scop., SF: (F) Old fields. FI-93. NF: (L) FI-252; Test.

#### CORNACEAE (Dogwood Family)

Cornus alternifolia L. f., Pagoda Dogwood. SF: (F) Moist northern hardwoods. FI-110; Clover. NF: (F) Northern hardwoods. FI-375.

C. canadensis L., Bunchberry. NF: (F) Lowland conifer forest. 3317.

C. rugosa Lam., Round-leaved Dogwood. SF: (C) Woods bordering dunes and shores. F1-38; Clover; Wolf. NF: (F) Shores. F1-417; Test.

C. stolonifera Michaux, Red-osier. SF: (C) Dunes and shores. F1-20; Wolf. NF: (F) Shores. F1-265; Test.

# CRASSULACEAE (Orpine Family)

Sedum acre L., Mossy Stonecrop. SF: (L) Escape, lighthouse area. FI-96.

S. telephium L., Live-forever. SF: (L) Escape, lighthouse area and north end of airstrip. 3818.

# CRUCIFERAE [BRASSICACEAE] (Mustard Family)

Arabis drummondii A. Gray, NF: (O) Woods bordering dunes and shores. 3101.

A. hirsuta (L.) Scop., SF: (L) South end of airstrip. 4032; Wolf.

A. lyrata L., Sand Cress. SF: (C) Dunes and shores. F1-58. NF: (F) Dunes and shores. F1-320; Test.

Barbarea vulgaris R. Br., Yellow Rocket. SF: (F) Shaded trails. 3119, 3379; FI-186. Berteroa incana (L.) DC., Hoary Alyssum. SF: (C) Old fields. FI-243; Test.

Cakile edentula (Bigelow) Hook., Sea-rocket. SF: (C) Dunes and shores. F1-49. NF: (F) Dunes and shores. F1-246; Test.

Camelina microcarpa DC., SF: Wolf.

Capsella bursa-pastoris (L.) Medikus, Shepherd's Purse. SF: (F) Old fields. 3139; F1-216; Wolf. NF: (O) Shaded trails. 3085; F1-299.

Cardamine pensylvanica Willd., SF: (O) Moist northern hardwoods. 3129, 3349, 3386, 3791, 4023, 4632. NF: (O) Wet northern hardwoods. 3305.

Dentaria diphylla Michaux, Two-leaved Toothwort. SF: (F) Northern hardwoods. 3140. NF: (F) Northern hardwoods. 3067; FI-442.

D. laciniata Willd., Cut-leaved Toothwort. SF: (O) Northern hardwoods. 3105. NF: (O) Northern hardwoods. 3094.

Lepidium campestre (L.) R. Br., SF: (F) Old fields. 3334, 3364.

L. densiflorum Schrader, SF: (F) Old fields. FI-211; Wolf.

Rorippa palustris (L.) Besser, Field Mustard. SF: (L) Old field east of airstrip. F1-224. Sisymbrium altissimum L., Hedge Mustard. SF: Wolf.

S. officinale (L.) Scop., Hedge Mustard. SF: (L) Disturbed ground near lumber camp and along trails. 3846, 3850, 4647.

# ELAEAGNACEAE (Oleaster Family)

Shepherdia canadensis (L.) Nutt., Buffaloberry. SF: (F) Shores. FI-47. NF: (F) Shores. FI-262; Test.

# ERICACEAE [sensu lato] (Heath Family)

Arctostaphylos uva-ursi (L.) Sprengel, Bearberry. SF: (C) Dunes and shores. FI-199. NF: (C) Dunes and shores. 3100; FI-251; Test.

Monotropa hypopithys L., Pine Sap. SF: (L) Wolf. NF: (L) Lowland conifer forest. 4622.

M. uniflora L., Indian Pipe. NF: (O) Lowland conifer forest. 3730.

Pyrola chlorantha Sw., SF: (L) Woods bordering dunes on east side, Sec. 33. 3356.

P. elliptica Nutt., Shinleaf. SF: (O) Northern hardwoods. FI-178. NF: (O) Northern hardwoods. FI-377.

P. secunda L., One-sided Pyrola. SF: (F) Woods bordering dunes and shores. FI-121, FI-85; Wolf. NF: (O) Lowland conifer forest. 3316.

Vaccinium myrtilloides Michaux, Velvet-leaf Blueberry. NF: (R) Gravel beach along north shore. 4766.

# **EUPHORBIACEAE** (Spurge Family)

Euphorbia corollata L., Flowering Spurge. SF: (L) Old field near airstrip. FI-180. E. polygonifolia L., Seaside Spurge. SF: (L) Dunes Sec. 33. 3807.

# FAGACEAE (Beech Family)

Fagus grandifolia Ehrh., Beech. SF: (C) Northern hardwoods. FI-235. NF: (C) Northern hardwoods. FI-318.

Quercus rubra L., Red Oak. SF: (O) Woods bordering shores. FI-31; Clover. NF: (O) Woods bordering shores. FI-450.

# FUMARIACEAE (Fumitory Family)

Corydalis aurea Willd., Golden Corydalis. SF: (L) Shaded trails. 4777. NF: (L) Shaded trails. 3974; Test.

Dicentra canadensis (Goldie) Walp., Squirrel-corn. SF: (C) Northern hardwoods. 3144. NF: (C) Northern hardwoods. 3095.

D. cucullaria (L.) Bernh., Dutchman's-breeches. SF: (C) Northern hardwoods. 3151. NF: (C) Northern hardwoods. 3096.

# GENTIANACEAE (Gentian Family)

Menyanthes trifoliata L., Buckbean. NF: (L) Pool in lowland conifer forest near gravel beach along north shore. 3739.

# GERANIACEAE (Geranium Family)

Geranium bicknellii Britton, SF: (L) Lumber camp. 4778.

G. maculatum L., SF: (R) Northern hardwoods near beach just south of dunes of Sec. 33. 4779.

G. robertianum L., Herb-robert. SF: (F) Northern hardwoods. 4776; FI-88; Test. NF: (O) Northern hardwoods. 4768.

# GROSSULARIACEAE (Gooseberry Family)

Ribes americanum Miller, Wild Black Currant. NF: (O) Moist northern hardwoods. 4008; FI-374.

R. cynosbati L., Wild Gooseberry. SF: (F) Northern hardwoods. FI-241; Clover. NF: (F) Northern hardwoods. FI-424.

# GUTTIFERAE [CLUSIACEAE] (St. John's-wort Family)

Hypericum kalmianum L., Kalm's St. John's-wort. NF: (L) Gravel beach along north shore. 3741.

H. perforatum L., Common St. John's-wort. SF: (C) Old fields. FI-50; Test. NF: (L) Airstrip. 4616.

# LABIATAE [LAMIACEAE] (Mint Family)

Leonurus cardiaca L., Common Motherwort. SF: (O) Old fields and shaded trails. FI-212; Clover; Wolf.

Lycopus americanus Muhlenb., Water Horehound. SF: (O) Moist northern hardwoods. 3769. NF: (C) Airstrip and wet northern hardwoods. 3754; FI-363; Test.

L. uniflorus Michaux, SF: (C) Moist northern hardwoods. 3768. NF: (C) Airstrip and wet northern hardwoods. 3716, 3755.

Mentha arvensis L., SF: (L) Wet field, Sec. 32 north of waterhole field. 3774. NF: (F) Edge of pool inside lowland conifer forest. 3733.

Nepeta cataria L., Catnip. SF: (O) Old fields. FI-197; Wolf.

Prunella vulgaris L., Self-heal. SF: (F) Shaded trails. FI-144; Wolf. NF: (O) Shaded trails. FI-337.

Satureja vulgaris (L.) Fritsch, Basil. SF: (F) Old fields and shores. FI-12; Wolf.

Scutellaria galericulata L., Common Skullcap. NF: (O) Airstrip. FI-381.

S. lateriflora L., Mad Dog Skullcap. NF: (O) Wet northern hardwoods. 3704.

# LEGUMINOSAE [FABACEAE] (Bean Family)

Lathyrus japonicus Willd., Beach Pea. SF: (C) Dunes and shores. FI-7; Clover. NF: (C) Dunes and shores. FI-247; Test.

L. palustris L., NF: (L) Pool in lowland conifer forest near gravel beach along north shore. 3735.

L. sylvestris L., Everlasting Pea. SF: (L) Persisting at lighthouse area, 3822.

Medicago lupulina L., Black Medic. SF: (O) Old fields. FI-229. NF: (L) Airstrip. 4614. M. sativa L., Alfalfa. SF: (L) Waterhole field. 4643.

Melilotus alba Medikus, White Sweet Clover. SF: (F) Old fields. FI-210.

Trifolium aureum Pollich, Hop Clover. NF: (L) Airstrip. 3761.

T. dubium Sibth., SF: (L) Lighthouse area. FI-89.

T. hybridum L., NF: (L) Old field, Sec. 4 N. 4773.

T. pratense L., Red Clover. SF: (F) Old fields. FI-18. NF: (O) Airstrip. FI-358.

T. repens L., White Clover. SF: (F) Old fields and shaded trails. F1-193, F1-223. NF: (F) Airstrip and shaded trails. F1-300, F1-372.

Vicia villosa Roth, Hairy Vetch. SF: (F) Old fields. F1-233.

#### LOBELIACEAE (Lobelia Family)

Lobelia kalmii L., Kalm's Lobelia. NF: (O) Airstrip. FI-355.

# MALVACEAE (Mallow Family)

Malva neglecta Wallr., Common Mallow. SF: (L) Airstrip. FI-218.

# MORACEAE (Mulberry Family)

Humulus lupulus L., Hops. SF: (L) Escape, lighthouse area. 3817.

# OLEACEAE (Olive Family)

Fraxinus americana L., White Ash. SF: (C) Northern hardwoods. F1-196. NF: (C) Northern hardwoods. F1-316.

F. nigra Marshall, Black Ash. SF: (R) Northern hardwoods west of airstrip. 3365. NF: (O) Wet northern hardwoods. FI-393.

F. pennsylvanica Marshall, Red Ash. SF: Wolf. NF: (L) Moist northern hardwoods. 3301, 3705.

Syringa vulgaris L., Lilac. SF: (L) Planted at lighthouse area. 3370; F1-100. NF: (R) Planted at Walter house. 3996.

# ONAGRACEAE (Evening Primrose Family)

Circaea alpina L., Dwarf Enchanter's Nightshade. SF: (F) Northern hardwoods and woods bordering perched dunes. 3385; FI-107. NF: (F) Northern hardwoods. 3964; FI-429.

C. lutetiana L., NF: (O) Northern hardwoods. F1-427.

Epilobium angustifolium L., Fireweed. NF: (L) Airstrip. FI-354.

E. ciliatum Raf., SF: (O) Wet northern hardwoods. 3837.

E. coloratum Biehler, NF: (O) Airstrip. 3723.

E. leptophyllum Raf., NF: (O) Airstrip. FI-414.

Oenothera oakesiana (A. Gray) S. Watson & J. Coulter, SF: (C) Dunes and shores. 3809; FI-2; Clover. NF: (F) Dunes and shores. FI-253.

O. parviflora L., NF: (L) Shores. 3688.

# OROBANCHACEAE (Broom-rape Family)

Epifagus virginiana (L.) Barton, Beech-drops. SF: (F) Northern hardwoods. 3827. NF: (C) Northern hardwoods. FI-441.

Orobanche fasciculata Nutt., Broom-rape. SF: (L) Perched dunes. F1-204. Michigan threatened species.

O. uniflora L., One-flowered Cancer-root. SF: (L) Disturbed northern hardwoods between lumber camp and north end of airstrip. 3391. NF: (O) Northern hardwoods near dunes and shores. 3295; F1-278, F1-446.

# OXALIDACEAE (Wood-sorrel Family)

Oxalis acetosella L., NF: (L) Wet northern hardwoods. 3324.

O. stricta L., SF: (O) Old fields. 3845, 4650, 4661.

# PAPAVERACEAE (Poppy Family)

Sanguinaria canadensis L., Bloodroot. SF: (F) Northern hardwoods. 3108; F1-162. NF: (L) Test.

# PLANTAGINACEAE (Plantain Family)

Plantago lanceolata L., English Plantain. SF: (F) Old fields. 3820. NF: (O) Airstrip. Fl-360.

P. major L., NF: (O) Airstrip and other disturbed sites. 3752, 3748, 4610, 4615.

P. rugelii Decne., Pale Plantain. SF: (L) Shaded trails. 4640; FI-194.

#### POLYGALACEAE (Milkwort Family)

Polygala paucifolia Willd., Flowering Wintergreen. SF: (F) Woods bordering dunes and shores. 3147. NF: (F) Woods bordering dunes and shores. 3098.

# POLYGONACEAE (Smartweed Family)

Polygonum aviculare L., Knotweed. SF: (O) Old fields. F1-219.

P. cilinode Michaux, Fringed False Buckwheat. SF: (O) Lighthouse area. 3824; FI-101; Wolf. NF: (O) Shady trails. 3972; FI-345.

P. convolvulus L., Black-bindweed. SF: (L) Airstrip. 4662.

P. hydropiperoides Michaux, Mild Water-pepper. SF: Wolf.

P. lapathifolium L., Willow-weed. NF: Test.

P. persicaria L., Lady's-thumb. SF: (L) Old field, SE 1/4 of Sec. 32. 4649.

P. ramosissimum Michaux, Jointweed. NF: (L) Gravel beach along north shore. 3744.

Rumex acetosella L., Sheep Sorrel. SF: (F) Shaded trails. FI-167; Clover. NF: (O) Shores. 3332.

R. crispus L., Sour Dock. SF: (F) Airstrip and shores. 3350, 3835. NF: (F) Shaded trails. FI-370.

R. obtusifolius L., Bitter Dock. SF: (F) Shaded trails. 3812; FI-27; Wolf. NF: (F) Shaded trails. FI-312; Test.

# PORTULACACEAE (Purslane Family)

Claytonia caroliniana Michaux, Carolina Spring Beauty. SF: (C) Northern hardwoods. 3107. NF: (C) Northern hardwoods. 3077.

Portulaca oleracea L., Common Purslane. SF: (L) Airstrip. FI-221.

# PRIMULACEAE (Primrose Family)

Lysimachia thyrsiflora L., Tufted Loosestrife. NF: (L) Edge of airstrip. 3308. Trientalis borealis Raf., Star Flower. NF: (F) Woods bordering dunes and shores. 3099, 3965.

#### RANUNCULACEAE (Buttercup Family)

Actaea pachypoda Elliott, White Baneberry. SF: (F) Northern hardwoods. FI-82; Wolf. NF: (F) Northern hardwoods. FI-291.

A. rubra (Aiton) Willd., Red Baneberry. SF: (O) Northern hardwoods. FI-72. NF: (O) Northern hardwoods. FI-325.

Anemone cylindrica A. Gray, Thimbleweed. SF: (F) Shores. 3338; FI-21, FI-22; Clover; Wolf. NF: (O) Shores. 3740.

A. multifida Poiret, Red Anemone. SF: (F) Dunes. 3124; FI-66.

A. quinquefolia L., Wood Anemone. SF: (L) Northern hardwoods, Sec. 33 below Nipissing bluff. 3120. NF: (L) Northern hardwoods north of airstrip. 3078.

A. virginiana L., NF: (L) Woods near blowout. FI-282.

Aquilegia canadensis L., Wild Columbine. SF: (C) FI-192; Clover. NF: (C) Shores. FI-451.

Caltha palustris L., Marsh Marigold. SF: (L) Moist shaded swale west of airstrip. 3132. NF: (C) Wet northern hardwoods. FI-335.

Coptis trifolia (L.) Salisb., Goldthread. NF: (L) Lowland conifer forest. 3075.

Hepatica acutiloba DC., Sharp-leaved Hepatica. SF: (C) Northern hardwoods. 3118; FI-165. NF: (C) Northern hardwoods. FI-287; Test.

Ranunculus abortivus L., Small-flowered Buttercup. SF: (F) Northern hardwoods. 3115, 3131; FI-78. NF: (C) Northern hardwoods. 3090, 3302; FI-313.

R. acris L., Common Buttercup. SF: (F) Old fields. 3770.

R. hispidus Michaux, Swamp Buttercup. NF: (O) Wet northern hardwoods. 3092, 3304, 4007.

R. recurvatus Poiret, Hooked Crowfoot. SF: (O) Northern hardwoods. FI-112. NF: (F) Northern hardwoods. 3976; FI-311.

Thalictrum dasycarpum Fischer & Avé-Lall., NF: (L) Gravel beach along north shore. 4626.

T. dioicum L., Early Meadowrue. SF: (O) Northern hardwoods. FI-80; Clover. NF: (O) Northern hardwoods. FI-298.

# ROSACEAE (Rose Family)

Agrimonia gryposepala Wallr., SF: (F) Northern hardwoods. F1-166; Wolf. NF: (L) Edge of pool inside lowland conifer forest. 4625.

A. striata Michaux, SF: (L) Moist northern hardwoods. 3766.

Amelanchier interior Nielsen, SF: (O) Woods bordering dunes and shores. 3135; FI-208; Clover. NF: (O) Woods bordering dunes and shores. 3082, 4597, 4601; FI-271.

A. laevis Weig., SF: (O) Woods bordering dunes and shores. 3138. NF: (O) Woods bordering dunes and shores. 3069, 3074, 4592.

A. sanguinea (Pursh) DC., SF: (O) Old field edges. 3136, 4635.

A. spicata (Lam.) K. Koch, SF: Clover. NF: (O) Woods bordering dunes and shores. F1-421.

- Fragaria vesca L., Woodland Strawberry. SF: (O) Woods bordering dunes and shores. FI-75. NF: (F) Woods bordering dunes and shores. FI-434.
- F. virginiana Duchesne, Wild Strawberry. SF: (C) Shores. FI-64. NF: (F) Shores. FI-256.
- Geum aleppicum Jacq., SF: (O) Shaded trails. FI-185; Clover. NF: (L) Edge of pool inside lowland conifer forest. 4627.
- G. canadense Jacq., SF: (F) Northern hardwoods. 3813; FI-136; Wolf. NF: (F) Northern hardwoods. FI-296.
- Malus pumila Miller, Apple. SF: (L) Persisting in some old fields. 3777. NF: (L) Escape on gravel beach, north side. 4765.
- Physocarpus opulifolius (L.) Maxim., Nine-bark. NF: (L) Gravel beach along north shore. 3071; Test.
- Potentilla anserina L., Silverweed. SF: (O) Shores. FI-62. NF: (O) Shores and airstrip. 3980; FI-404; Test.
- P. argentea L., Silvery Cinquefoil. SF: (O) Old field east of airstrip. F1-220; Wolf. NF: (L) Airstrip. 3760.
- P. norvegica L., Rough Cinquefoil. SF: (L) Old field near lumber camp. FI-222. NF: Test.
- P. recta L., Sulfur Cinquefoil. SF: (F) Old fields. FI-92; Wolf.
- *Prunus avium* (L.) L., Sweet Cherry. SF: (L) Planted at Plank Farm near lumber camp. 3137.
- P. pensylvanica L. f., Pin Cherry. SF: (F) Old fields. 3116; F1-207; Clover. NF: (O) Airstrip. 3060.
- P. pumila L., Sand Cherry. SF: (C) Dunes and shores. 3133; F1-30; Clover. NF: (F) Dunes and shores. F1-270; Test.
- P. virginiana L., Choke Cherry. SF: (F) Woods bordering dunes and shores. F1-33; Clover; Wolf. NF: (O) Woods bordering dunes and shores. F1-319; Test.
- Rosa blanda Aiton, SF: (F) Shores. FI-32; Clover. NF: (F) Shores. 3283; FI-279, FI-419.
- R. eglanteria L., Sweetbriar. SF: (F) Shores. F1-15. NF: (O) Shores. 3981.
- Rubus parviflorus Nutt., Thimbleberry. SF: (F) Woods bordering dunes and shores. Fl-57; Clover. NF: (F) Woods bordering dunes and shores. 3293; Fl-448.
- R. pubescens Raf., Dwarf Raspberry. NF: (L) Wet northern hardwoods. 3296.
- R. strigosus Michaux, Wild Red Raspberry. SF: (O) Woods bordering dunes and shores. FI-236; Clover. NF: (O) Woods bordering dunes and shores. FI-266.
- Sorbus decora (Sarg.) Schneider, Mountain-ash. SF: (F) Woods bordering dunes and shores. FI-226; Clover; Wolf. NF: (F) Woods bordering dunes and shores. 3073, 3291.
- Spiraea ×vanhouttei (Briot) Carr., Bridal-wreath. SF: (L) Planted at lighthouse area. 3369.

# RUBIACEAE (Madder Family)

- Galium aparine L., Cleavers. SF: (F) Northern hardwoods. FI-134, FI-163. NF: (O) Northern hardwoods. 3982; FI-290.
- G. triflorum Michaux, Sweet Scented Bedstraw. SF: (C) Northern hardwoods. 3344; FI-73, FI-87, FI-171; Wolf. NF: (C) Northern hardwoods. FI-301; Test.
- Mitchella repens L., Partridge-berry. SF: (F) Northern hardwoods. FI-169; Clover; Wolf. NF: (F) Northern hardwoods. FI-330; Test.

#### SALICAEAE (Willow Family)

- Populus balsamifera L., Balsam Poplar. SF: (F) Shores. F1-53, F1-237. NF: (C) Shores. F1-259
- P. grandidentata Michaux, Big-tooth Aspen. SF: (L) Woods bordering shore just north of lumber camp. 4655. NF: (F) Woods bordering dunes and shores and lowland conifer forest. FI-260.
- P. tremuloides Michaux, Quaking Aspen. SF: (C) Shores. FI-43; Clover. NF: (C) Shores. FI-261.

Salix bebbiana Sarg., Beaked Willow. NF: (F) Airstrip and shores. 3062, 4001; F1-275, F1-383, F1-420.

S. cordata Michaux, Sand-dune Willow. SF: (O) Dune pools of dunes on east side, Sec. 33. 3150. NF: (O) Airstrip. FI-386.

S. discolor Muhlenb., Pussy Willow. NF: (O) Airstrip. 4002; FI-387.

S. exigua Nutt., Sandbar Willow. SF: (O) Shores. FI-99. NF: (O) Airstrip. FI-385.

S. lucida Muhlenb., Shining Willow. NF: (O) Airstrip. 4003; FI-384.

### SANTALACEAE (Sandalwood Family)

Geocaulon lividum (Richardson) Fern., SF: (L) Border of woods and dunes, Sec. 33. 3149.

# SAXIFRAGACEAE (Saxifrage Family)

Mitella diphylla L., Bishop's Cap. SF: (F) Northern hardwoods. FI-177.

M. nuda L., Naked Miterwort. SF: (O) Woods bordering perched dunes. 3111; FI-113. NF: (F) Northern hardwoods. 3063, 3318.

Philadelphus coronarius L., SF: (L) Persisting at lighthouse area. FI-95.

# SCROPHULARIACEAE (Figwort Family)

Agalinis purpurea (L.) Pennell, NF: (L) Airstrip. 3756.

Melampyrum lineare Desr., Cow-wheat. NF: Test.

Pedicularis canadensis L., Wood Betony. SF: (O) Woods bordering dunes and shores. 3121; FI-13.

Verbascum thapsus L., Common Mullein. SF: (O) Old fields. F1-227. NF: (L) Shore along east side. 3707.

Veronica americana (Raf.) Schwein., American Brooklime. SF: (L) Shaded trails. 3389. V. arvensis L., Corn Speedwell. SF: (O) Shaded trails. 3368, 4771.

V. serpyllifolia L., SF: (O) Shady trails. 3146, 4774; Wolf.

# SOLANACEAE (Nightshade Family)

Physalis heterophylla Nees., Clammy Groundcherry. SF: (F) Old fields. 3778; FI-176; Clover; Wolf.

Solanum carolinense L., Horse Nettle. SF: (L) Old field, Sec. 32 SE 1/4. FI-156.

S. dulcamara L., Nightshade. NF: (O) Moist northern hardwoods. 3299; FI-339.

S. nigrum L., SF: (F) Shaded trails. 3779; Wolf.

### TILIACEAE (Basswood Family)

Tilia americana L., Basswood. SF: (F) Northern hardwoods. FI-36; Clover. NF: (O) Northern hardwoods. FI-263.

#### ULMACEAE (Elm Family)

Ulmus americana L., American Elm. NF: (L) Wet northern hardwoods at south end of island. 4600.

#### UMBELLIFERAE [APIACEAE] (Parsley Family)

Daucus carota L., Wild Carrot. SF: (F) Old fields. F1-231. NF: (L) Disturbed ground near Walter house. 3747.

Heracleum maximum Bartram, Cow-parsnip. SF: (F) Northern hardwoods. FI-143; Wolf. NF: (F) Northern hardwoods. FI-306; Test.

Osmorhiza chilensis Hook. & Arn., SF: (O) Northern hardwoods. 3373; FI-71. NF: (O) Northern hardwoods. 3978.

- O. claytonii (Michaux) C. B. Clarke, SF: (C) Northern hardwoods. FI-129; Clover; Wolf. NF: (C) Northern hardwoods. FI-294; Test.
- O. longistylis (Torrey) DC., SF: (O) Northern hardwoods. 4772. NF: (O) Northern hardwoods. 3973.

Pastinaca sativa L., Wild Parsnip. SF: (L) Shaded trail west of airstrip. FI-191.

Sanicula marilandica L., SF: (O) Northern hardwoods. 3339; FI-187. NF: (L) 3986; FI-341; Test.

S. trifoliata E. Bickn., SF: (O) 3776; Clover.

Sium suave Walter, NF: (F) Airstrip. FI-324.

# VERBENACEAE (Vervain Family)

Verbena hastata L., SF: (L) Airstrip. 3834.

# VIOLACEAE (Violet Family)

Viola adunca Smith, SF: (L) Perched dunes. 3125.

V. blanda Willd., Sweet White Violet. SF: (O) Moist northern hardwoods. 3113. NF: (F) Wet northern hardwoods. FI-437.

V. canadensis L., Canada Violet. SF: (C) Northern hardwoods. FI-135; Test; Wolf. NF: (C) Northern hardwoods. 3093; FI-304.

V. conspersa Reichb., Dog Violet. SF: (F) Woods bordering dunes and shores. 3112, 3122. NF: (F) Woods bordering dunes and shores. 3066, 3089, 3975.

V. pubescens Aiton, Yellow Violet, SF: (C) Northern hardwoods. 3145; FI-77. NF: (C) Northern hardwoods. 3091; FI-435.

V. renifolia A. Gray, NF: (L) Lowland conifer forest. 3068.

V. selkirkii Goldie, Great-spurred Violet. SF: (O) Northern hardwoods. FI-116. NF: (O) Northern hardwoods. FI-436.

V. sororia Willd., NF: (L) Wet northern hardwoods. 3088.

# VITACEAE (Grape Family)

Vitis riparia Michaux, River-bank Grape. SF: (F) Shores. FI-26.

#### **ACKNOWLEDGMENTS**

I'd like to thank Tom Stevens, Erwin Gale, and Stanley Riley, the previous owners of the private property on South Fox Island, and Bill and Susan Walter, owners of North Fox Island, for permission to explore those islands. I appreciate the assistance of my pilots, Ben Bricker (1985 and 1986) and Dick Sander (1987), when shuttling me and the rest of my gear between the islands and the mainland. Transportation costs for these trips were covered by a small grant from the Clarence R. and Florence N. Hanes Fund. Collecting during those trips was much easier due to the massive collection made with the help of Sue Hendricks, Greg Fons, Paul Thompson, and Jim Wells during the *Noble Odyssey* trip in 1984. I'd like to thank Ed Voss and Tony Reznicek for reviewing much of that collection and others which I have made since. Brent Venneman assited in the preparation of Figs. 2 and 3. Page charges for this paper were covered by a grant from the Briar Cliff College Faculty Development Committee.

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# REVIEW

MEDICINAL WILD PLANTS OF THE PRAIRIE. By Kelly Kindscher. University Press of Kansas, 2501 West 15th St., Lawrence, KS 66049. 1992. 340 pp. \$25 (cloth), \$9.95 (paperback) (plus \$2.50 shipping and handling).

The book has several missions: that of giving out information about prairies and as a repository of Indian words, uses, and stories involving medicinal plants of the prairie. There are 43 plants which are arranged by Latin genus with illustrations, range maps, common names, Indian names, scientific name, description, habitat, parts used, Indian use, Anglo folklore, medicinal history, scientific research, and harvesting/cultivation. There are 60 more plants with briefer write-ups, and many other species are scattered throughout the book.

There is a glossary and a extensive bibliography (225 entries). A reader would need access to an eclectic variety of literature in order to place the short quotes and comments in context (such as the Herba Polish Revista Italiana Essenze Profumi, and 1951 Illinois Natural History Survey circular). Many of the sources in the Bibliography are not directly related to the Prairie Bioregion.

Plants were used for spiritual healing and not necessarily solely because they contained medicinal substances. The dilemma is whether or not to publish oral traditions when asked not to do so by an informant. Kindscher gets out of this predicament by claiming, "I am a student of deeper truth" and refuses to write some of his alleged information. But evidently only sometimes. If he read it somewhere he will pass it along. There is a bit of the smugness of the medicine man, it seems to me, that he is not "allowed" to tell us everything.

Some comparisons can be made with the Edible Wild Plants of the Prairie (by the same author) which I reviewed in 1987. The choppy short sentences do nothing to show off long lists of Indian words and meanings, especially when comments and quotes are of any length. Again, Kindscher makes use of probably when he thinks aloud; I would rather these unknowns be simply left out-"probably all native plants had Indian names." The author's personal interpretations often detract from, rather than add to, the authenticity of the book: "... I have chewed the root of the American licorice for several minutes, but it still tasted only faintly sweet."

Botanical definitions and drawings are good, and there is a good section on different types of prairies and their agricultural uses. Kindscher points out that there is no prairie in the national park system and that prairie plants can be interesting and attractive cultivated plants. Because there are no keys, the reader must be able to identify the plants before using the book.

There are, however, several eye-opening uses: wearing smooth sumac leaves around the hands in order to remove dog meat from a boiling pot (by the Cheyennes), use of the chewed root of *Psoralea esculenta* by the Blackfeet, who "... blew it into a baby's rectum to treat gas pains," or the use of yarrow: "... inser[t] a bit of the stalk of the [A]chillea millefolium, about an inch long, in the skin and setting fire to the exposed end, and allowing it to burn down into the flesh."

It is true that this assemblage of plants is found in the Prairie Bioregion, but only one (coneflower) is confined to that area. Many of the others are found throughout a much larger area. He rationalizes the inclusion here by saying, "[I]t is probable that the information was shared and used similarily." If there is scanty knowledge about a plant in the prairie region, it does not deter him—he discusses plants outside of the area, such as a lengthy write-up of the European species of licorice. He has chosen an area and makes the plants fit into it—a fact which man seems to to do only too quickly in any available space.

This book is a useful resource for anyone interested in fleshing out knowledge of the uses of medicinal plants of the Prairie Bioregion and who wishes to have his ecological Prairie Bioregion consciousness raised.

> —Ellen Elliott Weatherbee Matthaei Botanical Gardens Ann Arbor, MI 48195-9741

# THE BIG TREES OF MICHIGAN. 3. Quercus bicolor Willd.

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Michigan's largest known swamp white oak is located on Grosse Ile in Wayne County. Currently the tree is considered a State and National Champion. Damage resulting in reduction of height may, however, result in revocation of its National Champion status.

Description of the species: Oaks are members of the beech family, Fagaceae. The american beech (Fagus grandifolia Ehrh.) and the american chestnut (Castanea dentata (Marshall) Borkh.) comprise the members of other genera of Fagaceae found in Michigan (Voss 1985). Quercus is distinct from the other genera by having an acorn, a one-seeded dry indehiscent fruit. Leaves of oaks range from entire to deeply lobed. Voss (1985) listed seventeen species of Quercus in his Michigan Flora. The swamp white oak is in the white oak group, distinguished by leaves with lobes being rounded or blunt without a bristle tip. Acorns in the white oak group are among the leaves at the branch tip where they ripen in their first year. Swamp white oak is distinguished from the other oaks of Michigan by having acorns usually in pairs on the peduncle (Fig. 1). The leaves are often irregularly lobed, dark green, shiny above and white and densely pubescent below. Swamp white oaks are characteristic of damp lowland forest (Curtis 1959).

Location of Michigan's Big Tree: The largest swamp white oak in Michigan is located on Grosse Ile one block east of Meridian Road on the south side of Bridge Road. The tree is easily seen from the road, it being found in a neatly groomed park area surrounded by basswood, silver maple, sugar maple, and planted pines. The tree is only 11 m from the road. It bears an aluminum Michigan Botanical Club sign indicating its champion status. Another swamp white oak in the area is labeled as a Michigan Big Tree. It is located on E. River Rd. and has a girth of 173" (440 cm).

Description of Michigan Big Tree: The tree has a single solid, healthy trunk. The circumference of the tree at breast height was measured on October 25, 1992 at 211" (533 cm) [Diameter = 67" (170 cm)]. The crown spread was measured at 82' (25 m), a 30% decrease in crown spread compared to that reported by Thompson (1986). The crown is pruned on its north side due to the presence of power lines. The tree is 108 feet (32.9 m) tall, much shorter than the 139 feet (42.4 m) reported by Thompson (1986).



FIGURE 1. Documented distribution in Michigan and characteristics of the swamp white oak. Map is from Voss (1985), the star indicates the location of Michigan's Big Tree. Drawings are from Barnes and Wagner (1981). 1. Winter twig, ×2; 2. Leaf, ×1/2; 3. Flowering shoot, ×1/2; 4. Male flower, enlarged; 5. Female flower, enlarged; 6. Fruit, acorn, ×1.

Observational evidence suggests that the center main branch of the trunk was removed, presumably by storm damage. The lowest remaining branch of the main trunk is 28 feet (8.5 m) from the ground. Since State Champion trees are determined by girth its State Champion status remains. The reduction in crown size, however, may affect its National Champion status.

# INVITATION TO PARTICIPATE

If you would like to join us in extending this series of articles by visiting and describing one or more of Michigan's Big Trees please contact Elwood B. Ehrle for help with locations, specifications for taking measurements,

and assistance with the manuscript. The Michigan Botanical Club encourages your involvement in this activity. Please remember to ask permission before entering private property.

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# **ANNOUNCEMENT**

# **Symposium Publication**

# BIOLOGICAL POLLUTION: THE CONTROL AND IMPACT OF INVASIVE EXOTIC SPECIES

On 25–26 October 1991, The Indiana Academy of Science hosted the above symposium. The Academy has just announced the availability of a publication by the same name, including 21 of the presentations given at the meeting. The 260 page volume includes articles on both aquatic and terrestrial ecosystems which focus on causes, case studies, control measures, management practices, ecologic and economic consequences, and policy issues. Readers of *The Michigan Botanist* may be particularly interested in several of the papers: "Problems with Biotic Invasives: A Biologist's Viewpoint" (Warren H. Wagner, Jr.—The University of Michigan), "Distribution and Spread of the Invasive Biennial Garlic Mustard (*Alliaria petiolata*) in North America" (Victoria Nuzzo; see Michigan Bot. 32: 23–33. 1993), and "Legal Aspects for Controlling Exotics" (Faith Thompson Campbell, National Resources Defense Council).

The volume costs \$24.00 (Indiana Academy members and persons who attended the conference), \$30.00 (all other orders) + \$2.50 postage/handling (\$1.00 for each additional copy). Checks should be made payable to the Indiana Academy of Science; orders submitted via a purchase order are subject to a \$2.00 fee.

Orders should be sent to: Bill N. McKnight, IAS Publications, 1102 North Butler Ave., Indianapolis, IN 46219.

A review of this publication will appear in a forthcoming number.

# VASCULAR PLANT SPECIES NEW TO HILLSDALE COUNTY, MICHIGAN

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# INTRODUCTION

The detailed distribution maps in *Michigan Flora* (Voss 1972, 1985) have not only been valuable as summaries of species range estimates within the state, but also have made apparent the presence of wide variation in our floristic knowledge of Michigan counties. For example, Washtenaw and Berrien counties possess three to five times as many species records as Branch and Kalkaska, even though the sizes of these counties are relatively equivalent. Although real species diversity differences among counties may account for a part of this variation, probably the vast proportion is attributable to sampling error resulting from collectors' neglect of certain areas. This error poses no significant problem in the case of, say, Toxicodendron radicans (L.) Kuntze, a species documented in all counties except Kalkaska. Since this species is known to be all too abundant throughout the state, T. radicans likely occurs in that county but simply has not been documented there. However, for species of sporadic occurrence, interpretation of gaps is more problematic if one is using a distribution map suspected to be incomplete. In the case of a threatened or endangered species, the problem of poorly surveyed areas becomes acute and could profoundly affect guidelines and policy decisions. For this reason there is a need for floristic surveys of undercollected Michigan counties.

# HILLSDALE COUNTY

Hillsdale County appears to be significantly undercollected. Voss (1972, 1985) documented only 314 species from this county in the gymnosperms, monocots, and non-sympetalous dicots. This is less than one third of the total for the heavily collected Washtenaw County (over 1000). A tally of the latitudinal tier of Michigan counties which includes Hillsdale illustrates the paucity of records from this county relative to the others (Fig. 1). Only Branch County possesses a lower number of species records. Some of the variation among counties is no doubt due to higher habitat diversity within lakeside counties (dunes, swales, mud flats, extensive marshes, and beaches in addition to inland habitats), resulting in higher species diversity relative to inland counties. However, most of the variation probably results from

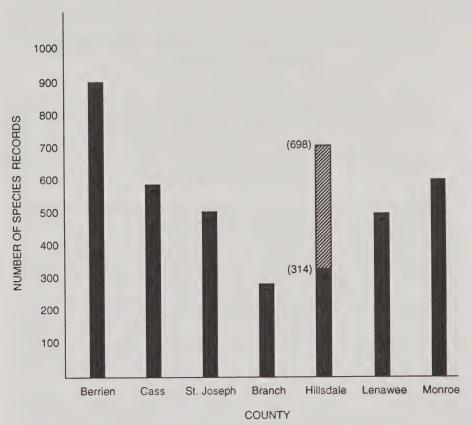


FIGURE 1. Total number of species records (Gymnospermae-Cornaceae, Englerian sequence) in each county along the southern border of Michigan (synthesized from records in Voss 1972, 1985). Counties are arranged in order from west to east. The striped bar indicates additional species records, nearly all of which result from collections made during this survey.

the lack of adequate surveying within Hillsdale and Branch. Therefore, I conducted a floristic survey of Hillsdale County to provide a more complete record of the vascular plants occurring in south-central Michigan.

Hillsdale County is located in extreme southern Michigan, slightly east of the midpoint between Lake Michigan and Lake Erie. The southwestern corner of the county is Michigan's most southerly point and borders Ohio and Indiana. The dominant physiographic feature is the Fort Wayne end moraine, traversing the county in a northeast-southwest direction. Two river systems flow from this moraine; one drains south to the Maumee River, the other northwest to Lake Michigan. Both primary rivers of these systems are named the St. Joseph River, although they do not meet (contrary to what some road maps suggest). On the west side of the county occur

two north-south-oriented and more or less interrupted chains of lakes, each about 15 km long. Hillsdale County soils are derived from glacial deposits generally comprised of sandy or gravelly outwash in the northwestern third of the county and till in the southeastern two-thirds (Farrand & Bell 1982). Kettle-kame topography, as well as acidic soils and wetlands are rare; rock outcrops are absent. Most of the original non-swampy forest has been converted to farmland (Veatch et al. 1928), especially in the county's eastern townships, although many forested patches still remain and old-field succession is common. Many of the lakeshores have been converted to residential areas and summer cottages. There are no federal lands or state parks. In fact, the only state- or county-owned area as large as six square miles is the Lost Nation State Game Area in the east-central part of the county.

#### **METHODS**

Field work was carried out from 1985 to 1990. All townships were surveyed. Collecting localities are too numerous to record here but are available upon request and at the University of Michigan Herbarium, where the first set of all vouchers is deposited; some noteworthy localities are discussed below. In general, the southern and western townships proved to be the most botanically diverse, primarily due to the lakes and intact floodplains there.

# **RESULTS**

I made 1012 collections, categorized as follows: 1) 374 species included in Michigan Flora parts I and II (Voss 1972, 1985; Gymnospermae-Cornaceae, Englerian sequence) but not previously documented for Hillsdale County (Appendix); 2) 10 species new to the county which would otherwise be included in Michigan Flora parts I and II but are not, for reasons of dubious natural occurrence, prior undocumented status, or taxonomic opinion; 3) 37 species of ferns and fern-allies, 30 of which are new to the county (Appendix); 4) nearly 200 species belonging to the families Ericaceae-Compositae; since they will be included in Michigan Flora Part III (E.G. Voss, pers. comm.) they are not listed here. Two other collections made by Edward G. Voss, three by Anton A. Reznicek, and five by Allison W. Cusick (Appendix) fall into category (1) above. Records include one species new to Michigan (Chorispora tenella; see also Fritsch (1992) regarding Scutellaria nervosa Pursh, a sympetalous dicot from Hillsdale County new to Michigan), two species endangered in Michigan, three species threatened in Michigan, and 12 species of special concern in Michigan (Michigan Department of Natural Resources 1992; Appendix). In addition, it is likely that four species previously considered either threatened or of special concern in Michigan (Carex sychnocephala, Panicum philadelphicum, Rumex maritimus, and Geum vernum; Beaman et al. 1985) have been removed from the most recent listing of Michigan's endangered and threatened plants partly as a result of Hillsdale County collections made during the present survey.

# DISCUSSION

The new collections herein more than double the number of species known from Hillsdale County at the time of publication of parts I and II of Michigan Flora, Hillsdale County now possesses the second highest number of species records among the counties comprising the southernmost Michigan tier (Fig. 1). This confirms the suspicion that the low number of species records documented for Hillsdale prior to this study was to a large extent artifactual. There are several reasons some Michigan counties have been collected more than others, including 1) the presence of a university or college with a strong botanical curriculum in or near the county, 2) the presence of an interstate or other good roads affording easy travel for collectors, 3) the appeal of the county to collectors (e.g., does it include physiographic features potentially harboring botanically interesting communities and/or designated natural areas such as parks, wilderness areas, or other public lands?), and 4) the presence of one or several active amateur collectors studying the local county flora. Reasons 1, 2, and 4, and possibly to some extent 3, all contributed to the prior lack of species records for Hillsdale County.

# SELECTED LOCALITIES

Several localities possessing habitats unique within Hillsdale County or otherwise of interest are described below, along with a discussion of noteworthy collections found at each. New species records for Hillsdale County from these localities are indicated in the Appendix. Nomenclature follows that in the Appendix. Numbers within parentheses indicate the author's collection numbers.

- A. Swampy shore and adjacent beech-maple woods at Long Lake, T7S, R4W, 4.5 km NE of Reading—his area is the best example in Hillsdale County of an old growth beech forest and is one of the few preserved sites in Hillsdale County, having been established by the county and the Nature Conservancy. Plants seen from here and nowhere else within the county include *Epifagus virginiana* (L.) Barton (occasional), *Habenaria psycodes* (rare), *Liparis loeselii* (rare), and *Panax quinquefolius* (occasional).
- B. Tamarack fen, T7S, R2W, N end of Lost Nation State Game Area, 10 km SE of Hillsdale—This is the only known Hillsdale County locality for Cypripedium candidum Willd. (local; a threatened Michigan species), Eleocharis pauciflora (local), Eriophorum angustifolium (local), Geum rivale L. (600; local), and Ptelea trifoliata L. (745, rare on adjacent upland). Gentianopsis procera (Holm) Ma (838) and Valeriana uliginosa (Torrey & A. Gray) Rydb. are abundant at this site, and Rhynchospora capillacea is locally common.

- C. Closed bog and adjacent birch stand, T7S, R2W, 9 km SE of Hillsdale This is the only occurrence in the county for Andromeda glaucophylla (1154), Betula papyrifera, Carex oligosperma, Chamaedaphne calyculata (L.) Moench (983), and Nemopanthus mucronatus. These primarily boreal species are rare in southern Michigan, their ranges extending southward only to northern Indiana in the central United States. The locality is also interesting in that two hybrid individuals of Betula were found, one between B. papyrifera and B. alleghaniensis, the other between B. papyrifera and B. pumila (B. × sandbergii). Betula alleghaniensis is frequent at the site, whereas B. papyrifera is occasional, although several moderately-sized dead trunks of B. papyrifera are still standing. B. pumila L. was not found, despite intensive searching. The idea that hybridization occurs more frequently in populations where one parent is common and the other rare (e.g., Arnold et al. 1993) seems to apply here, in both hybrid cases. Presumably, one or several plants of B. pumila exist or recently existed somewhere in the bog, accounting for the existence of the hybrid.
- D. Tamarack/red maple lowland with bog remnants, T8S, R4W, SW of Montgomery, near the western county line—Eriophorum viridicarinatum (Engelm.) Fern. (628) and Triglochin maritimum occur in the unshaded bog remnants; Coptis trifolia (L.) Salisb. (968) occurs at the border of the wetland in deep shade. These species range only as far south as northern Indiana and Ohio and E. viridi-carinatum and C. trifolia were seen in this survey only once.
- E. Floodplain and adjacent rich woods on the St. Joseph River, T9S, R3W, 8 km SE of Camden-Much of the area is owned by a scouting camp based just south of the Michigan-Ohio border, and so appears to be adequately protected. This locality is the most intact stretch of floodplain forest in the county. Numerous species collected here were found nowhere else in the county, including Aralia racemosa, Aristolochia serpentaria, Athyrium pycnocarpon, A. thelypterioides, Cercis canadensis, Diarrhena americana, Dryopteris goldiana, Fraxinus quadrangulata Michaux (1050), Gymnocladus dioicus, Hybanthus concolor, Juglans cinerea, Morus rubra, Scutellaria nervosa (1141), and Ulmus thomasii. In addition, Asimina triloba (L.) Dunal (1047) and Arisaema dracontium, species rare in Hillsdale County, were found. Diarrhena americana is local in the central lowlands, but increases in abundance toward Missouri. At this site the population consisted of a single cluster of culms; since this species is rhizomatous, the number of individuals could not be ascertained. Aristolochia serpentaria was highly local at the edge of the floodplain forest. This species is confined to the southern two tiers of Michigan counties at the northern limit of its range. A thorough search of the floodplain is needed to determine the abundance of these and the other rarities occurring there. A flora of this species-rich area, including the Ohio extension of the floodplain, would be a significant contribution to the floras of both Michigan and Ohio.

- F. Rich woods with buckeye on high bank of Clark Fork Creek, T9S, R3W, 14 km SE of Camden—Aesculus glabra Willd. (377) is a dominant tree here. Also present is Geum vernum (occasional), Senecio obovatus Muhlenb. (367, locally common), and Viburnum prunifolium L. (368, occasional), the latter being infrequent in Michigan and confined to the southern tier of counties.
- G. Boggy shore and associated uplands in the Denton Lakes region, T7S, R4W, 5 km W of Reading—This is the only place I saw Cornus canadensis and Drosera rotundifolia L. (1032), reflecting the county's paucity of acidic wetlands. Other species found here and nowhere else in the county include Fragaria vesca (upland), Galium labradoricum (Wieg.) Wieg. (1038; bog), Pyrola rotundifolia L. (1122; upland), P. elliptica Nutt. (1046; upland), and Vaccinium macrocarpon Aiton (1036; bog). All these species were rare except for the Vaccinium which was frequent.

H. Tamarack/red maple swamp and boggy shore of Little Bear Lake, T7S, R3W, 7 km SW of Hillsdale – Rhamnus alnifolia L'Hér. (342) and Trientalis borealis Raf. (346), both rarely seen in Hillsdale County, are

present.

- I. Wet meadow and adjacent oak woods, R3W, T5S, 14 km E of Litch-field—The locality is noteworthy for the presence of *Arabis lyrata*, which is found locally on the black oak upland bordering the swamp. Other localities inland from the Great Lakes occur in Michigan, especially in the western part of the state, but are not isolated from the main range as is this one.
- J. Exposed mud flat and gravel at edge of drying pond, T5S, R2W, 2 km E of Moscow—Carex sychnocephala was locally abundant at the east end of this pond. This species ranges from Ontario and New York, westward to Saskatchewan and Montana, and southward to Iowa. It is very local throughout its range, especially eastward (Mackenzie 1935). This and three other species found here, C. viridula (locally abundant), Eleocharis intermedia (occasional), and Fimbristylis autumnalis (locally abundant) are characteristic of mucky shores where the water level is receding. Growing with Fimbristylis was Panicum tuckermanii (rare). Rumex maritimus, a species rare in Michigan, was occasional at the less muddy north end of the pond.

K. Tamarack fen, T8S, R4W, near the St. Joseph River, 2.5 km N of Montgomery – This is the only recent Hillsdale County locality for *Cypripedium calceolus* L. (1005; occasional); *Cypripedium reginae* Walter is

also present (local).

# CONCLUSION

Conservation efforts in Hillsdale County should focus on the habitats and species listed above. In this regard, considering that so much of the natural vegetation is disturbed or gone, it is suggested that more preserves be designated in Hillsdale County, particularly to protect the plants found

there that are of special concern or threatened in Michigan, but also to guarantee the opportunity to enjoy what is left of the county's natural heritage.

New species records from undercollected counties such as Hillsdale can provide insight into the nature of floristic differences within the state as well as contribute to databases that will allow larger-scale floristic analyses. Although the floristic knowledge of extreme southern Michigan has been improved as a result of this survey, Branch County, which is adjacent to and west of Hillsdale, is still poorly known. An extensive survey of Branch County would provide a more complete data set contributing to the characterization of species distributions and diversity in the southernmost part of the state.

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#### APPENDIX: NEW HILLSDALE COUNTY RECORDS

Species from Gymnospermae to Cornaceae (Englerian sequence) new to Hillsdale County subsequent to publication of Michigan Flora (Voss 1972, 1985). A list of species of ferns and fern-allies collected is also included; \* = those mapped in Billington (1952) or Hagenah (1966) for Hillsdale County. Species in parentheses are not included in Voss (1972, 1985). Collection numbers after each species are those of the author unless otherwise indicated. Nomenclature and author citations follow Lellinger (1985) for the ferns and fern-allies, and Voss (1972, 1985) for all others except for the species not included there, in which case Gleason and Cronquist (1991) is followed. Species not bold-faced are known or probable introductions to Michigan, according to Voss (1972, 1985). a = new Michigan record; b = endangered in Michigan; c = threatened in Michigan; d = of special concern; e = other rare Michigan records (found in < 6 counties; most or all of these are exotics). Capital letters after collection numbers refer to localities listed in the text.

#### **PTERIDOPHYTES**

# LYCOPODIACEAE

Lycopodium clavatum L., 661

L. digitatum Dillen. 1024

L. lucidulum Michaux, 495

L. obscurum L., 662

#### SELAGINELLACEAE

Selaginella eclipes Buck, 720; D

# **EQUISETACEAE**

\*Equisetum arvense L., 725

E. fluviatile L., 995

E. hyemale L., 13, 723, 727

E. laevigatum A. Braun, 604; B

E. variegatum Schleich. ex Fried. Weber & Mohr, 1128

# **ASPLENIACEAE**

Asplenium platyneuron (L.) BSP., 72

# DENNSTAEDTIACEAE

Pteridium aquilinum (L.) Kuhn, 724

# DRYOPTERIDACEAE

Dryopteris ×boottii (Tuckerman) L. Underw., 1121, 1232

D. carthusiana (Villars) H.P. Fuchs, 380

D. clintoniana (D.C. Eaton) Dowell, 672, 731, 1229, 889; A

D. cristata (L.) A. Gray, 1032

D. goldiana (Hook.) A. Gray, 1186; E

D. intermedia (Muhlenb.) A. Gray, 1242

D. marginalis (L.) A. Gray, 1107; F

D. ×triploidea Wherry, 1223, 1230

D. ×uliginosa Druce, 1231

Polystichum acrostichoides (Michaux) Schott, 525

# **OPHIOGLOSSACEAE**

Botrychium dissectum Sprengel, 71, 779, 984

\*B. virginianum (L.) Sw., 1

# **OSMUNDACEAE**

\*Osmunda cinnamomea L., 624

\*O. regalis L., 47

#### SINOPTERIDACEAE

Adiantum pedatum L., 513

#### **THELYPTERIDACEAE**

Thelypteris hexagonoptera (Michaux) Weath., 381

T. noveboracensis (L.) Nieuwl., 1131

\*T. palustris Schott, 486

#### WOODSIACEAE

\*Athyrium filix-femina (L.) Roth,

732, 865, 1079; K

A. pycnocarpon (Sprengel) Tidestrom, 1115; E

A. thelypterioides (Michaux) Desv., 1113; E

Cystopteris protrusa (Weath.) Blasdell, 1112; E

C. tenuis (Michaux) Desv., 494

Matteuccia struthiopteris (L.)

Todaro, 1114: E

\*Onoclea sensibilis L., 1118; E

# **GYMNOSPERMS**

#### **PINACEAE**

Pinus strobus L., 665

#### MONOCOTYLEDONS

#### ALISMATACEAE

Alisma plantago-aquatica L., 44 Sagittaria latifolia Willd., 12

# **ARACEAE**

Acorus calamus L., 1133

Arisaema dracontium (L.) Schott,

1116, 1119; E

Peltandra virginica (L.) Schott &

Endl., 734; A

#### **CYPERACEAE**

<sup>e</sup>Carex aggregata Mackenzie, 1068

C. alata Torrey, 688

C. albursina E. Sheldon, 975; E

C. aurea Nutt., 207

C. bebbii (L. Bailey) Fern., 625; D

C. buxbaumii Wahlenb., 1016

C. careyana Dewey, 956

C. conoidea Willd., 1019

C. crinita Lam., 408

dC. davisii Schwein & Torrey, 1057

C. digitalis Willd., (A. W. Cusick 25303)

C. flava L., 365

dC. frankii Kunth, 1104

C. gracilescens Steudel, 357

C. granularis Willd., 205

C. interior L. Bailey, 621; D

C. intumescens Rudge, 1208

d. jamesii Schwein, 378

C. laxiculmis Schwein, 1021

C. leptalea Wahlenb, 343; H

dC. lupuliformis Dewey, 765

C. lurida Wahlenb, 1045; E

C. muskingumensis Schwein, (A. A. Reznicek 9244)

C. oligosperma Michaux, 1155; C

C. pedunculata Willd., 524

C. plantaginea Lam., 977; E

C. prairea Dewey, 356; H

C. prasina Wahlenb., (A. A. Reznicek 8933)

C. rostrata Stokes, 535, 1018

C. sartwellii Dewey, 603; B

C. sprengelii Sprengel, 942, 987

C. sterilis Willd., 601, 999, 1004; B,

C. stricta Lam., 540, 1015

C. swanii (Fern.) Mackenzie, 402

C. sychnocephala Carey, 878; J

C. tenera Dewey, 1069

C. tetanica Schk., 605, 1008; B

C. tribuloides Wahlenb., 51

C. viridula Michaux, 882; J

C. vulpinoidea Michaux, 639

Cladium mariscoides (Muhlenb.) Torrey, 719; D

Cyperus diandrus Torrey, 880; J

C. erythrorhizos Muhlenb., 832

C. esculentus L., 816

C. filiculmis Vahl, 309

dC. flavescens L., (A. W. Cusick 25834)

C. odoratus L., 886; J

C. rivularis Kunth, 121; H

C. strigosus L., 836

Eleocharis acicularis (L.) Roemer & Schultes, 659, 786

E. elliptica Kunth, 1058

dE. equisetoides (Elliott) Torrey, 1172

E. intermedia Schultes, 876; J

E. obtusa (Willd.) Schultes, 927; C

E. pauciflora (Light.) Link, 609; B E. quadrangulata (Michaux) Roemer

& Schultes, 43

E. rostellata Torrey, 1145; G

E. smallii Britton, 419

Eriophorum angustifolium Honck., 677; B

E. virginicum L., 1156; C

Fimbristylis autumnalis (L.) Roemer & Schultes, 881; J

Rhynchospora capillacea Torrey, 699; B

Scirpus cyperinus (L.) Kunth, 28 S. pendulus Muhlenb., (A. W.

Cusick 26615)

S. subterminalis Torrey, 1175

S. validus Vahl, 611, 678; B

#### **GRAMINEAE**

Agropyron trachycaulum (Link) Malte, 1142; K

Agrostis gigantea Roth, 696

A. hyemalis (Walter) BSP., 1235

A. perennans (Walter) Tuckerman, 1207

Andropogon scoparius Michaux, 108 Anthoxanthum odoratum L., 589

Avena sativa L., 311

Bromus ciliatus L., 675; B

B. commutatus Schrader, 385

B. japonicus Murray, 717, 1052

Calamagrostis inexpansa Gray, (A. W. Cusick 26608)

Cenchrus longispinus (Hackel) Fern.,

Cinna arundinacea L., 918

Dactylis glomerata L., 541

Danthonia spicata (L.) Roemer & Schultes, 640

<sup>c</sup>Diarrhena americana P. Beauv., 1181; E

Echinochloa muricata (P. Beauv.)

Fern., 1222 Eleusine indica (L.) Gaertner, 742

Elymus riparius Wieg., 113

E. villosus Willd., 1163

Eragrostis hypnoides (Lam.) BSP., (A. W. Cusick 25827)

E. cilianensis (All.) Mosher, 323

E. pectinacea (Michaux) Nees, 744, 1147

E. spectabilis (Pursh) Steudel, 1214

eFestuca arundinacea Schreber, 799,
1188

E. octoflora Walter, 1099

F. octoflora Walter, 1099

F. rubra L., 1074

Glyceria septentrionalis A. Hitchc., 613

Hierochloë odorata (L.) P. Beauv., 510; I

Holcus lanatus L., 218

Leersia oryzoides (L.) Sw., 750

L. virginica Willd., 757

Leptoloma cognatum (Schultes) Chase, 114

Muhlenbergia glomerata (Willd.) Trin., 493; I

M. mexicana (L.) Trin., 835

Panicum capillare L., 35

P. depauperatum Muhlenb., 1044

P. dichotomiflorum Michaux, 768, 808

P. linearifolium Britton, 1065

P. tuckermanii Fern. (see P. philadelphicum Trin.), 879; J

Paspalum ciliatifolium Michaux, 895 Phragmites australis (Cav.) Steudel, 32

Poa alsodes A. Gray, 991

P. annua L., 947

P. compressa L., 206

P. sylvestris A. Gray, 1002

Puccinellia pallida (Torrey) R. T. Clausen, 614

Secale cereale L., 1073

<sup>e</sup>Setaria faberi F. Herm., 769

S. glauca (L.) P. Beauv., 53

<sup>e</sup>Sorghum halepense (L.) Pers., 1215

Spartina pectinata Link, 1130

Sphenopholis intermedia (Rydb.)

Rydb., 1084

Tridens flavus (L.) A. Hitchc., 867 Trisetum melicoides (Michaux) Scrib-

ner, 702; B

# HYDROCHARITACEAE

Vallisneria americana Michaux, 891;

#### **IRIDACEAE**

<sup>e</sup>Iris germanica L., 1059 I. pseudacorus L., 595 Sisyrinchium angustifolium Miller, 399

#### JUNCACEAE

Juncus acuminatus Michaux, 1152 d. biflorus Elliott, 1201

J. brachycephalus (Engelm.) Buchenau, 783

J. bufonius L., 1151

J. canadensis La Harpe, 123; H

e(J. compressus Jacq., 996)

J. effusus L., 49

J. marginatus Rostk., 398

J. nodosus L., 877, 1126; J

J. tenuis Willd., 120, 1095

J. torreyi Cov., 822, 1153; J Luzula acuminata Raf., 138, 753

#### **LEMNACEAE**

Lemna minor L., 518

# LILIACEAE

Allium canadense L., 204, 406

A. vineale L., 937, 1054, 1075

Asparagus officinalis L., 636 Convallaria majalis L., 961

eHemerocallis lilio-asphodelus L., 612

Ornithogalum umbellatum L., 569

e(Scilla siberica Andrz., 934)

Smilax ecirrata (Kunth) S. Watson,

S. illinoensis Mangaly, 1001

Tofieldia glutinosa (Michaux) Pers., 698; B

Trillium flexipes Raf., 671, 964; A

Yucca filamentosa L., 896

Zigadenus glaucus (Nutt.) Nutt., 693;

# **NAJADACEAE**

Najas guadalupensis (Sprengel) Magnus, 1236

<sup>e</sup>N. marina L., 1168

# **ORCHIDACEAE**

Cypripedium acaule Aiton, 622; D Habenaria psycodes (L.) Sprengel, 126; A

Liparis loeselii (L.) Rich., 673; A

#### **PONTEDERIACEAE**

Heteranthera dubia (Jacq.) Mac-Millan, 1167

# **POTAMOGETONACEAE**

Potamogeton crispus L., 928

P. foliosus Raf., 657

P. gramineus L., 1173

P. oakesianus Robbins, 905

P. richardsonii (A. Bennett) Rydb.,

P. robbinsii Oakes, 1170

#### **SPARGANIACEAE**

Sparganium americanum Nutt., 829 S. eurycarpum Engelm., 826

#### **TYPHACEAE**

Typha angustifolia L., 692

# **DICOTYLEDONS**

#### **ACERACEAE**

(Acer ginnala Maxim., 1064)

#### **AMARANTHACEAE**

Amaranthus albus L., 805 A. blitoides S. Watson, 842 A. powellii S. Watson, 801 A. retroflexus L., 1220

# **ANACARDIACEAE**

Rhus copallina L., 642

# **AQUIFOLIACEAE**

Ilex verticillata (L.) A. Gray, 46 Nemopanthus mucronatus (L.) Loes., 922; C

#### **ARALIACEAE**

Aralia racemosa L., 1180, 1187; E <sup>c</sup>Panax quinquefolius L., 674; A

#### **ARISTOLOCHIACEAE**

<sup>c</sup>Aristolochia serpentaria L., 1109; E Asarum canadense L., 376; F

# **BALSAMINACEAE**

Impatiens pallida Nutt., 729

#### BERBERIDACEAE

Berberis thunbergii DC., 773 Caulophyllum thalictroides (L.) Michaux, 669; A

#### **BETULACEAE**

Alnus rugosa (Duroi) Sprengel, 1092 Betula alleghaniensis Britton, 923; C B. papyrifera Marshall, 981; C B. pendula Roth, 663 (B. ×sandbergii Britton, 921; C) (B. alleghaniensis Britton × B. papyrifera Marshall, 982; C)

# **CANNABACEAE**

Humulus lupulus L., 1041

#### CARYOPHYLLACEAE

Cerastium nutans Raf., (E. G. Voss 16209)

C. semidecandrum L., 948
Dianthus armeria L., 70, 208
Saponaria officinalis L., 703
Scleranthus annuus L., 929
Stellaria media (L.) Villars, 131, 913

#### CELASTRACEAE

Celastrus scandens L., 394, 800 Euonymus fortunei (Turcz.) Hand.-Mazz., 935 dE. atropurpurea Jacq., 919

# CHENOPODIACEAE

Atriplex patula L., 815 Chenopodium album L., 746 C. glaucum L., 1146 Cycloloma atriplicifolium (Sprengel) J. Coulter, 839

#### **CISTACEAE**

Helianthemum bicknellii Fern., 1211 H. canadense (L.) Michaux, 1043 Lechea villosa Elliott, 1205

Alliaria petiolata (M. Bieb.) Cavara

#### CORNACEAE

Cornus amomum Miller, 65 C. canadensis L., 1035; G

#### **CRASSULACEAE**

Sedum acre L., 646

#### **CRUCIFERAE**

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# **PUBLICATION OF INTEREST**

THE RARE VASCULAR PLANTS OF THE ISLAND OF NEWFOUND-LAND / LES PLANTES VASCULAIRES RARES DE L'ILE DE TERRE-NEUVE. Andre Bouchard, Stuart Hay, Luc Brouillet, Martin Jean, and Isabelle Saucier. Syllogeus 65: 165 pp. 1991. Canadian Museum of Nature, Direct Mail Section, P.O. Box 3443, Station D, Ottawa, Ontario K1P 6P4, Canada. \$7.95 (Canadian): Canadian orders add \$3.00 shipping/handling + \$0.76 GST; orders sent outside of Canada add \$6.00 shipping/handling only. This is the 10th publication in a series of volumes, each detailing the rare plants of a province or territory, that have appeared at irregular intervals since 1977. For each of the 271 taxa that the authors determined to be rare in Newfoundland, the following information is given: scientific name, synonymy (if any), sources (herbaria and literature), North American range, Newfoundland range, other published distribution maps, habitat, "ecoregion" (occurrence according to Damman's division of the island into 9 ecoregions and 21 subregions), rarity status in Canada, and rarity status in Newfoundland. Dot maps are provided for each species as well as an extensive bibliography and list of excluded species (and reasons for their exclusion. The complete text of the detailed Introduction appears in both English and French, in this case as consecutive chapters [in early volumes, e.g. Ontario (Syllogeus 14), the entire text was bilingual, the two texts (one inverted) starting from opposite covers and meeting in the middle of the volume.]

While Newfoundland may be a bit far afield from the Great Lakes, this volume is brought forth to make our readers aware of this series on the rare plants of Canada. Other volumes (Syllogeus volume and date in parentheses) that have appeared are: Alberta (17, 1978; now out of print), British Columbia (59, 1985), Manitoba (27, 1980), New Brunswick (50, 1983), Nova Scotia (18, 1978), Ontario (14, 1977; now out of print), Prince Edward Island (67, 1991), Quebec (48, 1983; now out of print), Saskatchewan (20, 1979), Yukon Territory (28, 1981).

---Richard K. Rabeler

# **EDITOR'S NOTE**

It is with regret that I announce that I have tendered my resignation as Co-Editor of *The Michigan Botanist*, effective with the close of this volume. I have found that a change in some of my obligations, some botanical and some not, has sharply reduced the time that I have available to devote to *The Botanist*.

The past five years can be summarized in a number of different ways. Twenty numbers were produced, amounting to some 1,068 pages. Four of the numbers were single-article floras, increasing the total number of pages printed (and sometimes the complexities of production!) while reducing the number of papers that were printed. Advances in the composition and printing industry allowed us to accept manuscripts submitted on computer diskette; now it is the norm. The three-year index was reinstated, made possible by Neil Harriman's generous offer to produce it. The series of articles on the Big Trees of Michigan was initiated in 1992; three have appeared and more are on the way. A similar series on Michigan Botanists was proposed; the first article will appear shortly.

I would like to thank the authors, reviewers, and members of the Editorial Board for their assistance and cooperation. The assistance of the personnel at our composition house, Sans Serif Typesetters, Inc., as well as that of the three different printers who have produced the copies you have read has been invaluable.

While I cannot yet announce my successor, a candidate has been identified who is both familiar with the Michigan flora and has been associated with the Michigan Botanical Club for a number of years. I believe this individual will maintain the standards of the journal that you, our readers, have come to expect. Your continued support (especially in the form of submitted manuscripts!!) would be appreciated.

---Richard K. Rabeler

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On the cover: Pickerel-weed (Pontederia cordata)
Photographed by E. B. Mains